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THE MANUAL

OF THE

American Railroad Association

SIGNAL DIVISION

(Formerly Railway Signal Association)

SPECIFICATIONS

ISSUE OF 1920

Complete to December 31, 1919

Compiled for the Committee of Direction by the Editing Committee consisting of

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F. B. Wiegand

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THE MANUAL

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AND

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PREFACE.

The Manual of the American Railroad Association, Signal Division, was originally issued in 1912 by the Board of Direction of the Railway Signal Association in accordance with the Constitution of that body, which required the Board of Direction to issue a Manual of Recommended Practice containing the specifications and important standards of the Association, also approved findings and conclusions.

Revisions and additions are made yearly by the Signal Division and such new matter is identified with the date approved by the Division. The present edition, issued in two volumes, contains all matter which has received approval of the Railway Signal Association and of the Signal Division up to the date shown on title page. Subjects are classified alphabetically and, in addition, an index has been added to show quickly the contents of the specification section. The Standard Designs have been arranged numerically with an alphabetical and numerical index.

It is believed that the present work is the most valuable text on signaling in existence.

Suggestions which will make the Manual more valuable will be gladly received by the Committee compiling the Manual, and it is hoped that readers discovering errors will kindly bring them to the attention of the Committee.

1920.

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American Railroad Association.
Signal Division.

SPECIFICATIONS

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*Where additions or revisions have been made, the changes are designated at the end of sections by inserting date on which the change was made. The date appearing underneath the title is the year in which the subject was first adopted or revised.

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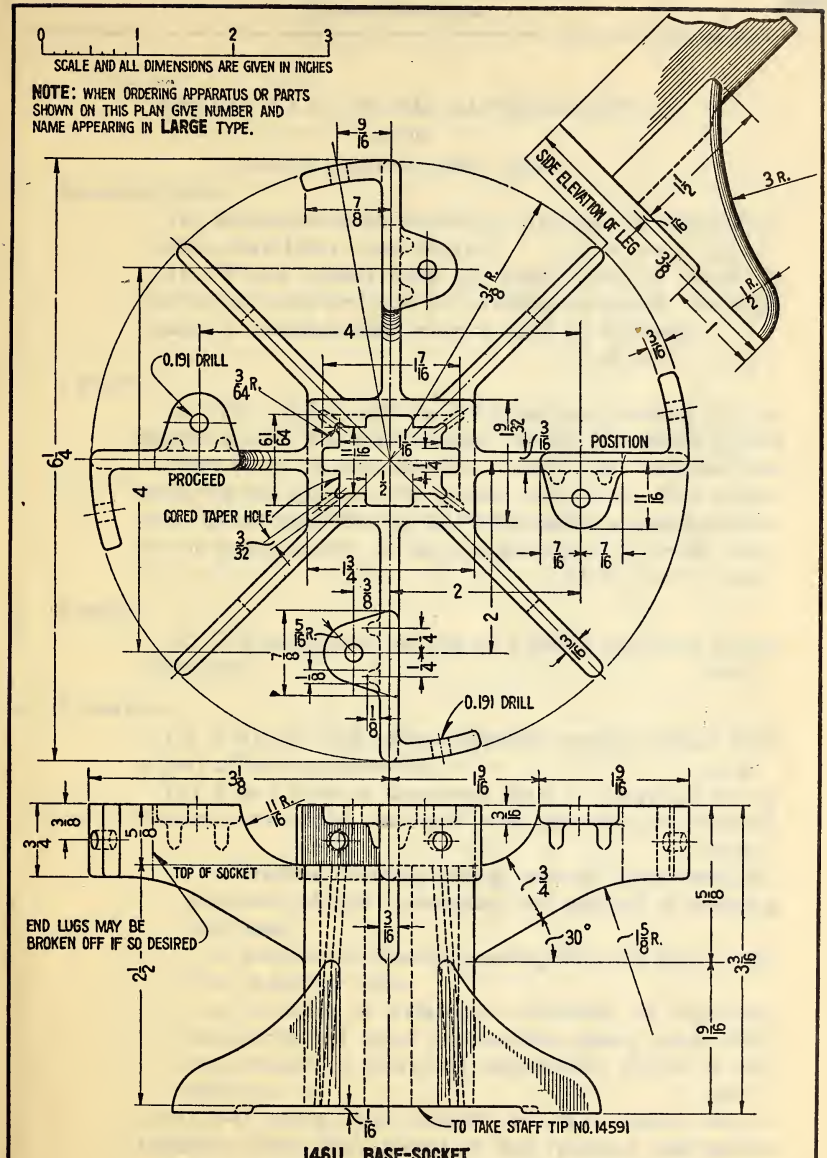
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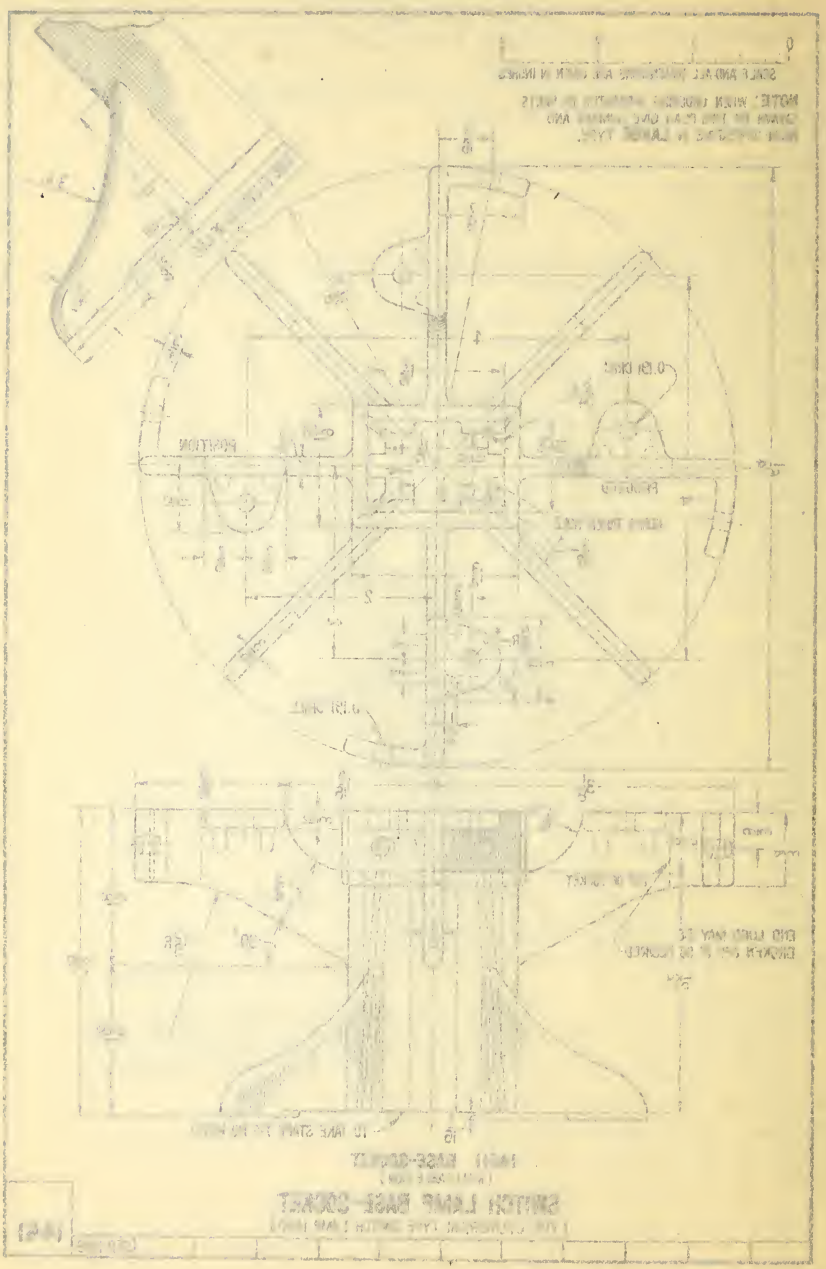
SCALE AND ALL DIMENSIONS ARE GIVEN IN INCHES
NOTE: WHEN ORDERING APPARATUS OR PARTS SHOWN ON THIS PLAN GIVE NUMBER AND NAME APPEARING IN LARGE TYPE.
SIDE ELEVATION OF LEG
3 R.
0.191 DRILL
PROCEED
POSITION
CORED TAPER HOLE
0.191 DRILL
TOP OF SOCKET
END LUGS MAY BE BROKEN OFF IF SO DESIRED
30°
TO TAKE STAFF TIP NO. 14591

14611 BASE-SOCKET
(MALLEABLE IRON)

SWITCH LAMP BASE-SOCKET
(FOR CYLINDRICAL TYPE SWITCH LAMP 1460)

SEP. 1919 **1461**



SPECIFICATION FOR ALTERNATOR.

1919.

(Official Approval May, 1920.)

1. *Requisite sheet.*

(a) Requisite sheet, section 23, attached to this specification, shall form a part thereof. (S. S. 4-a.) 1919.

(b) Where blanks have not been filled, or where an option is permitted and no preference stated, the Contractor's recommended practice shall be followed. (S. S. 4-b.) 1919.

2. *Tender.*

(a) The tender shall be for apparatus meeting the requirements of this specification. If the Contractor wishes to vary from the specification a tender may be submitted covering the apparatus he desires to furnish. This tender shall be accomplished by full information showing wherein the requirements of the specification are varied from. (S. S. 3-a.) 1919.

3. *Design.*

(a) The alternator shall be of a design approved by the Purchaser. 1919.

4. *Drawings.*

(a) Purchaser's drawings listed on requisite sheet form a part of this specification. 1919.

(b) The following drawings shall be attached to the Contractor's tender and shall be an essential part thereof. 1919.

1. Outline drawing giving over-all dimensions, dimensions of shaft extension, and method of bringing out leads.

2. Foundation drawings giving size and exact location of anchor bolts.

3. Drawing or catalogue reference of rheostats, regulators and other accessories, giving exact drilling dimensions, including diagramatic sketch of connections. 1917.

(c) Not more than number of days called for on requisite sheet after award of the contract, and before work is begun, the Contractor shall furnish, for the approval of the Purchaser, a set of drawings showing the design and dimensions of all apparatus and proper connections of all instruments to be furnished under this specification. 1917.

(d) Not more than number of days called for on requisite sheet after the receipt of these drawings, the Pur-

4-d. *Drawings.*—Continued

chaser will indicate any corrections that may be necessary, or signify his approval. 1917.

(e) The Contractor shall be responsible for the correctness of all drawings furnished by him, although the drawings may have been approved by the Purchaser. 1917.

(f) Any work done prior to the approval of the Contractor's drawings will be done at the Contractor's risk. 1917.

(g) No change shall be made in any approved drawing without the written consent of the Purchaser. 1917.

(h) After the contract is awarded each party shall furnish to the other necessary prints of his approved drawings. 1917.

5. *Material and workmanship.*

(a) Material and workmanship shall be first-class in every respect. (S. S. 5-a.) 1911.

(b) Additional work within the scope of the contract shall be done on the basis of the unit prices as stated in the contract. (G. P. 7-b.) 1911.

(c) They shall be acceptable under the rules of the National Board of Fire Underwriters and under the requirements of the local authorities. If any local requirements exist, a copy shall accompany the request for quotation and shall be referred to on requisite sheet. 1917.

6. *Bearings.*

(a) All bearings shall be readily replacable. The shaft shall be provided with suitable means to prevent the oil from working along the shaft to the rotor. Plain bearings shall be self-oiling, preferably of the ring type, and shall have ample surface to insure cool running. The upper halves of the main bearings are to be removable without removal or displacement of shaft, on sizes of fifty (50) k.v.a. and over. Bearing shall be provided with babbitted or bronze linings. 1917.

(b) When plain bearings are used, oil reservoirs capable of holding a liberal supply of oil and convenient gauges for indicating the height of the oil and outlets for drawing it off shall also be provided. There shall also be easy means for examining the operation of the oiling device. 1914.

7. *Doweling.*

(a) Adjoining portions of the machinery, where efficiency and good operation are affected by alignment, shall be doweled or rabbited together, dowels to be fitted to ac-

4-d Drawings—Continued

7-a. *Doweling.*—Continued.

curately reamed holes. Through dowels in all cases shall be provided with threads and a nut for withdrawal. Adjoining portions of the machinery shall be given corresponding marks when desirable for securing correct assembly. 1914.

8. *Rotor.*

(a) Rotor must be mechanically strong and able to run at twenty-five (25) per cent. overspread with safety. Fans or projecting parts of rotor must be screened in such manner that persons working about the alternator are not liable to injury. 1917.

(b) The finished rotor shall be properly balanced and run smoothly, without injury or vibration, under all conditions of operation. 1917.

9. *Collector rings.*

(a) Collector rings shall be so mounted that air can freely circulate around them, giving thorough ventilation. The construction of the rings shall be such that they can be easily removed and cleaned. 1914.

10. *Brushes.*

(a) Each brush shall be separately removable and adjustable without interfering with any of the others. All insulating washers and bushings shall be damp-proof and unaffected by temperature up to one hundred (100) degrees C. (212° F.). 1919.

11. *Field rheostat.*

(a) The field rheostat shall be of fireproof construction and suitable for mounting on back of switchboard, unless otherwise specified on requisite sheet. When so mounted it shall be provided with a shaft projecting through the front of the switchboard, either directly connected or by sprocket and chain. Hand-wheel for front of switchboard shall be supplied and shall be marked to indicate the direction of rotation for raising and for lowering the voltage of generator. The total range of adjustment shall be from fifteen (15) per cent. above to twenty (20) per cent. below the rated voltage at full load. This variation shall be approximately in steps of two (2) per cent. 1917.

12. *Wave shape.*

(a) The maximum deviation of the wave form on open circuit from sinusoidal shape shall not exceed ten (10) per cent. as determined by the A. I. E. E. Standardization Rules. 1917.

7-a. Doweling—Continued.

curately reamed holes. Through doweling in all cases shall be provided with threads and a nut for withdrawal. Adjoining portions of the machinery shall be given corresponding marks when desirable for securing correct reassembly.

8. Rotor.

(a) Rotor must be mechanically strong and able to run at twenty-five (25) per cent. overspeed with safety. Fans or projecting parts of rotor must be covered in such manner that persons working about the alternator are not liable to injury.

(b) The finished rotor shall be properly balanced and run smoothly without injury or vibration, under all conditions of operation.

9. Collector rings.

(a) Collector rings shall be so mounted that air can freely circulate around them, giving thorough ventilation. The construction of the rings shall be such that they can be easily removed and cleaned.

10. Brushes.

(a) Each brush shall be separately removable and adjustable without interfering with any of the others. All insulating supports and bushings shall be damp-proof and unaffected by temperature up to one hundred (one) degree C. (212° F.).

11. Field theorist.

(a) The said theorist shall be of the proper construction and suitable for mounting on back of switchboard, unless otherwise specified on requisite sheet. When so mounted it shall be provided with a shaft projecting through the front of the switchboard, either directly connected or by sprocket and chain. Hand-wheel for front of switchboard shall be supplied and shall be marked to indicate the direction of rotation for raising and for lowering the voltage of generator. The base rings of adjustment shall be from minus (15) per cent. above to twenty (20) per cent. below the rated voltage at full load. This variation shall be approximately in steps of (two (2) per cent.

12. Wave shape.

(a) The maximum deviation of the wave form on open circuit from standard shape shall not exceed ten (10) per cent. as determined by the A. I. E. E. Standardization Rules.

13. *Name-plate.*

(a) The name-plate shall be fitted to the alternator in a conspicuous place and be marked with information as required by A. I. E. E. 1917.

14. *Insulation.*

(a) Alternator shall withstand the standard test voltage of A. I. E. E. Standardization Rules and the insulation resistance of armature and field windings shall be in accordance with A. I. E. E. rules. 1917.

15. *Temperature.*

(a) Alternator shall carry normal load in k.v.a. at normal voltage, speed and power factor, continuously at a temperature rise not to exceed the standards of the A. I. E. E. Standardization Rules. 1917.

16. *Overload capacity.*

(a) Alternator shall be able to carry for one (1) minute at normal voltage at least one hundred and fifty (150) per cent. of rated load at power factor as stated on requisite sheet by varying exciter voltage; shall be able to withstand a momentary short circuit at normal operating excitation and normal speed and must be able to carry this short circuit for ten (10) seconds without injury. 1917.

17. *Inspection.*

(a) Purchaser may inspect the material at all stages of manufacture. (S. S. 6-a.) 1919.

(b) Purchaser may inspect the completed product to determine that the requirements of this specification have been met. (S. S. 6-b.) 1919.

(c) If the material has not been accepted at point of production, and if, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected, and the Contractor, upon request, shall advise the Purchaser what disposition is to be made of the defective material. The Contractor shall pay all freight charges. (S. S. 6-c.) 1919.

(d) If Purchaser is to make inspection at point of production, it shall be so stated. (S. S. 6-d.) 1917.

18. *Tests.*

(a) Tests may be made at point of production, or on samples submitted, and may also be made at destination. (S. S. 7-a.) 1919.

(b) Contractor shall give the Purchaser sufficient notice of time when material will be ready for testing. (S. S. 7-b.) 1919.

13. Name-plate.

(a) The name-plate shall be fixed in the alternator in a conspicuous place and be inscribed with information as required by A. I. E. E.

14. Insulation.

(a) Alternator shall withstand the standard test voltage of A. I. E. E. Standardization Rules and the temperature of commutator and field windings shall be in accordance with A. I. E. E. Rules.

15. Temperature.

(a) Alternator, shall carry normal load in kva. at normal voltage, speed and power factor continuously a temperature rise not to exceed the standards of the A. I. E. E. Standardization Rules.

16. Overload capacity.

(a) Alternator shall be able to carry for one (1) minute at normal voltage at least one hundred and sixty (160) per cent. of rated load at power factor as stated in specifications by varying exciter voltage, and be able to withstand a momentary short circuit at normal speed and exciter and normal speed and must be able to carry the same circuit for ten (10) seconds without injury.

17. Inspection.

(a) Purchaser may inspect the material in all stages of manufacture.

(b) Purchaser may inspect the completed product to determine that the requirements of this specification have been met.

(c) If the material has been accepted at point of production, and it upon arrival at destination it fails to meet the requirements of this specification it may be rejected and the Company, upon request, will replace the Purchaser with equal material. The decision as to the merits of the material shall be made by the Purchaser.

(d) If Purchaser is not present at time of inspection and test, the Company shall not be responsible for any defective material.

18. Tests.

(a) Tests may be made at point of production, or on samples submitted, and may also be made on receiving.

(b) Contractor shall give the Purchaser sufficient notice of time when material will be ready for testing.

18. *Tests.*—Continued.

(c) Contractor shall provide, at point of production, apparatus and labor for making the required tests under supervision of the Purchaser. (S. S. 7-c.) 1919.

(d) The following tests shall be made on all machines in accordance with A. I. E. E. Standardization Rules:

1. Test for polarity of field coils.
2. Test for resistance.
   (a) Ohmic resistance of field.
   (b) Ohmic resistance of armature.
   (c) Resistance of revolving element to be taken between collector rings. 1919.
3. Insulation.
   (a) High potential test between windings and frame to determine dielectric strength. 1919.
4. Saturation. (No load.) 1919.
5. Temperature. 1919.

19. *Packing.*

(a) Material shall be so prepared as to permit convenient handling and to protect against loss or damage during shipment. (S. S. 8-a.) 1919.

20. *Marking.*

(a) Purchaser's order, requisition and package number, name of Consignor and name and address of Consignee, shall be plainly marked on outside of package. (S. S. 9-a.) 1919.

(b) Detail list of loose pieces, containers and their contents, shall be furnished for each shipment. Where car-load shipments are made, routing and car identification shall be shown. (S. S. 9-b.) 1919.

(c) Where car-load shipments are made, name and address of Consignee may be omitted. (S. S. 9-c.) 1919.

21. *Warranty.*

(a) Contractor shall warrant the material covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to making, at point of production, any part or parts to replace those which shall be found defective within one (1) year after shipment to the Purchaser. This warranty shall not apply to any apparatus which shall have been repaired or altered in any way by anyone other than the Manufacturer thereof so as to, in the Contractor's judgment, affect its proper functioning or reliability nor which has been subject to misuse, negligence or accident. (S. S. 10-a.) 1919.

22. *Tools.*

(a) Lifting eyes, and special tools, required for assembling and disassembling the alternator shall be furnished. 1919.

23. *Requisites for alternator, A. R. A. specification.*

(a) Purchaser to fill in such items as he desires to specify. Contractor to fill in all other blanks, so that the requisite sheet will be complete when finally submitted with Contractor's quotations. 1919.

(b) Identification: Alternators covered by this sheet are for ..... R. R. on Inquiry ..... Order ..... Requisition ..... 1917.

(c) Alternator shall be furnished in accordance with A. R. A. specification. 1919.

(d) Characteristics.

1. Ratings.
   - (a) Rated capacity in k.v.a. .....
   - (b) Power factor .....
   - (c) Full load terminal voltage .....
   - (d) Phases .....
   - (e) Amperes per terminal .....
   - (f) Frequency in cycles per second .....
   - (g) Speed in r.p.m. .....

   1917.

2. Design.
   - (a) Connection { belt. / direct. } 1917.
   - (b) Driven by { internal combustion engine. / steam engine. / water wheel. / motor ..... } 1919.

3. Type.
   - (a) Revolving { field ..... / armature ..... } 1919.

4. Shaft.
   - (a) Extended for { flange coupling ..... / pulley ..... } 1919.
   - (b) Diameter of shaft in inches { alternator ..... / driving unit..... } 1917.

23-d. *Requisites for alternator, A. R. A. specification.*—Continued.

5. Pulley.
   (a) Pulley diameter ..... inches.
   (b) Pulley face ..... inches.
   1919.

6. Efficiency. 85% P.F. Rated P.F.
   (a) One-fourth (¼) load ....
   (b) One-half (½) load ....
   (c) Three-fourths (¾) load ....
   (d) Full load ....
   1917.

7. Regulation at normal k.v.a. output.
   (a) Eighty-five (85) per cent. P.F. .....
   (b) Rated per cent. P. F. .....
   (c) Regulation of fifty (50) per cent. load (without voltage regulator) P. F. .....
   1917.

8. Losses.
   (a) Short circuit loss or synchronous impedence .....
   (b) Windage and bearing friction .....
   (c) Core loss, open circuit .....
   (d) Core loss, short circuit .....
   1917.

9. Saturation.
   (a) Saturation (at full load) at per cent. P.F. specified. 1917.

10. Exciting current at normal volts and speed.
   (a) Eighty-five (85) per cent. P.F. rated k.v.a. .....
   (b) Rated P.F. ..... rated k.v.a. .....
   (c) ..... P.F. at one hundred and fifty (150) per cent. k.v.a. 1917.

11. Excitation.
   (a) Shall exciter be furnished? .....
   (b) Exciter normal volts .....
   (c) Exciting current shall be obtained from ..... volt d.c. source. 1919.

23-d. *Requisites for alternator, A. R. A. specification.*—Continued.

12. Rheostats.

(a) Shall be type ..... manufactured by .....

(b) Drilling template number .....

(c) Mounted { front of board. / back of board. / remote from panel. }

1917.

13. Voltage regulator.

(a) Shall voltage regulator be furnished? .....

(b) Shall be type ....., manufactured by ..... 1919.

14. Weight.

(a) Total net weight .....

(b) Total shipping weight .....

1917.

15. Base.

(a) { Bed plate / Slide rails } shall be furnished by { Purchaser ..... / Contractor ..... / Engine builder ..... }

1919.

(e) Installation.

1. Shall be installed by { Purchaser. / Contractor. }

1919.

(f) Drawings.

1. Following Purchaser's drawings are attached:

(a) ..... drawing, dated .....

(b) ..... drawing, dated .....

(c) Drawings approval: Contractor shall furnish final drawings for approval within not more than ..... days after the award of the contract.

(d) Purchaser shall indicate any corrections to Contractor's drawings within not more than ..... days after receipt of same. 1919.

23-d. *Requisites for alternator, A. R. A. specification.*—Continued.

(g) Material and workmanship.

1. Shall be in accordance with local requirements, copy attached as follows:

.....

..... 1917.

(h) Inspection or tests.

1. Shall inspections or tests be made at point of production under supervision of Purchaser? .....
2. ..... days' notice required by Purchaser before apparatus will be ready for inspection or test.
3. Shall inspection or tests be made at destination by Purchaser? .....
4. Shall record of inspection and tests as furnished by Contractor be accepted? ..... 1919.

(x) Remarks .....

.....

..... 1916.

(y) Signed ..... 1916.

(z) Date ..... 1916.

23-d. Requisites for alternating, d. c. c. apparatus.—Continued

INSTRUCTIONS FOR INSTALLATION AND HANDLING OF CAUSTIC SODA BATTERIES.

1919.

(Official Approval May, 1920.)

1. *Housing.*

(a) Housing must be such as to provide protection against rain, snow, extreme heat or cold. 1919.

(b) Where concrete boxes are used they must be installed with the bottom of the box at least ten (10) inches in the ground. 1919.

(c) Drainage must be provided as necessary to prevent flooding of housings. 1919.

(d) Cells must set level on floors, shelves or racks and arranged to permit of ready inspection of any cell or element. 1919.

(e) Housings must be kept clean and locked. 1919.

2. *Materials.*

(a) One (1) complete cell (except water) consists of the following:

1 Jar.	1 Unit (positive and negative elements assembled).
1 Cover.	1 Can caustic soda.
1 Hexagonal nut.	1 Bottle battery oil (When not self-contained in element).
2 Wing nuts.	
2 Washers.	

1919.

(b) Cases containing cells or renewals must be kept dry. 1919.

(c) Cells or parts should not be unpacked except as required. 1919.

(d) Caustic soda which has been damaged by exposure to air or dampness must not be used. 1919.

3. *Setting up new caustic soda cells and renewals.*

(a) Check material to see that jars, covers, terminals, nuts, washers, elements, caustic soda and oil (when not self-contained in element) are of proper size and quantity. 1919.

(b) Remove packing material and separators from assembled elements. 1919.

(c) Examine assembled elements. See that proper spacing exists and that connecting wire to zinc is firmly attached. Broken electrodes must not be used. 1919.

(d) Clean jars and covers thoroughly, observing their physical condition. Cracked jars or covers must not be used. 1919.

INSTRUCTIONS FOR INSTALLATION AND HANDLING OF CAUSTIC SODA BATTERIES

(Official Approval May, 1920.)

1. Housing.

(a) Housing must be such as to provide protection against rain, snow, and the cold.

(b) Where portable boxes are used they must be installed with the bottom of the box at least (10) inches in the ground.

(c) Drainage must be provided as necessary to prevent flooding of housing.

(d) Cells must ter level at floors, shelves or racks and arranged to permit of ready inspection of any cell or element.

(e) Housings must be kept clean and locked.

2. Materials.

(a) One (1) complete cell (exact water) consists of the following:

1 Jar	1 Unit (positive and negative elements assembled)
1 Cover.	
1 Hexagonal nut	1 Can caustic soda.
2 Wing nuts	1 Bottle battery oil (When not self-contained in element)
2 Washers.	

(b) Cases containing cells or renewals must be kept dry.

(c) Cells or parts should not be unpacked except as required.

(d) Caustic soda which has been damaged by exposure to air or dampness must not be used.

3. Setting up new caustic soda cells and renewals.

(a) Check material to see that jars, covers, terminals, nuts, washers, stoppers, caustic soda and oil (when not self-contained in element) are of proper size and quality.

(b) Remove packing material and separators from assembled elements.

(c) Examine assembled elements. See that proper spacing exists and that connecting wire to zinc is firmly attached. Broken electrodes must not be used.

(d) Clean jars and cover thoroughly, observing their physical condition. Cracked jars or covers must not be used.

3. *Setting up new caustic soda cells and renewals.*—Continued.

(e) Material unfit for use must be called to attention of proper official and disposed of in accordance with instructions. 1919.

(f) Use clean water for mixing solution. Water known to contain an excess of metallic salt, acid and alkali, sewage or other impurities must not be used. 1919.

(g) Fill jars with water to about two and one-half (2½) inches from the top. 1919.

(h) Add caustic soda gradually, stirring with clean stick of wood until thoroughly dissolved. 1919.

(i) Use exact amount of soda furnished for each cell. 1919.

(j) Exercise care in mixing and handling the solution as it is caustic and will burn the skin or clothing. If accidentally splashed on the skin or clothing, wash off immediately. 1919.

(k) Pass connecting wire and suspension bolt through holes in cover and tighten assembled elements securely to cover. 1919.

(l) Clean end of wire leading from zinc to insure good electrical contact. 1919.

(m) Insert assembled elements in solution and place jar where practicable in permanent location. Add water to bring top of solution three-fourths (¾) inch from top of jar with elements in position, and stir thoroughly. 1919.

(n) Add to top of solution exact amount and kind of oil furnished (except when oil is self-contained in element). 1919.

(o) When elements are placed in solution while hot, cells should be connected up at once. When not practicable to operate apparatus to cause immediate discharge, battery must be discharged at a rate not to exceed three (3) amperes for ten (10) minutes. 1919.

(p) When elements are placed in solution while hot, inspections should be made after battery cools and water added to bring top of oil five-eighths (⅝) inch from top of jar and solution again stirred. 1919.

(q) Connect cells in circuit in accordance with furnished plans or instructions. 1919.

(r) Changes in arrangement of connections must not be made without proper authority. 1919.

(s) Record must be kept showing dates batteries are installed, exhausted and renewed. 1919.

3 Setting up new cadmium cells and renewals.—Continued

(a) Material used for use must be called to attention of proper official and disposed of in accordance with instructions

(b) Use clean water for mixing solution. Water known to contain an excess of metallic salt, acid and alkali sewage or other impurities must not be used.

(c) Fill jars with water to about two and one-half inches from the top.

(d) Add caustic soda gradually, stirring with clean stick of wood until thoroughly dissolved.

(e) Use exact amount of soda furnished for each cell.

(f) Exercise care in mixing and handling the solution as it is caustic and will burn the skin or clothing. If accidentally splashed on the skin or clothing, wash off immediately.

(g) Pass connecting wire and suspension bolt through holes in cover and tighten assembled elements securely to cover.

(h) Clean end of wire leading from zinc to insure good electrical contact.

(i) Insert assembled elements in solution and place jar where practicable in permanent location. Add water to bring top of solution three-fourths (¾) inch from top of jar with elements in position, and stir thoroughly.

(j) Add to top of solution about ¼ inch layer of oil formulated (except when oil is unobtainable in any event).

(k) When elements are placed in solution wait half hour, then connect up at once. When not practicable to observe precaution to cause immediate discharge, battery must be discharged at a rate not to exceed three (3) amperes for ten (10) minutes.

(l) When elements are placed in solution which instructions should be made when battery cools and water added to bring top of oil one-eighth (⅛) inch from top of jar and solution again stirred.

(m) Connect cell in circuit in accordance with furnished plans or instructions.

(n) Changes in arrangement of connections must not be made without proper authority.

(o) Record must be kept showing dates batteries are installed, examined and renewed.

4. *Renewal of exhausted cells.*

(a) Except when necessary to make replacements, due to defect, all cells of a series connected battery must be renewed at same time. 1919.

(b) When removing or installing cells, care must be taken not to interrupt the normal operation of circuits. 1919.

(c) Old solution and empty soda cans must be buried when practicable; otherwise they must be deposited where they cannot cause damage. 1919.

5. *Inspection.*

(a) Batteries must be examined as often as necessary to prevent failures, and voltage readings must be taken of individual cells to check their condition. 1919.

(b) Jars and covers must be clean and connections tight and free from corrosion. 1919.

(c) Any unusual appearance of the elements or solution must be investigated. 1919.

(d) Defective cells must be reported and if defect cannot be remedied, cells must be replaced at once. 1919.

(e) Elements or solution removed on account of defects, must be saved intact for investigation. 1919.

6. *Disposition of exhausted elements.*

(a) Exhausted elements must be drained off and then spaced on racks, floors or shelves away from inflammable material and allowed to dry for three (3) days or longer, after which they must be packed in renewal cases and forwarded to the storehouse or other designated place, each case being marked to show the number and type of exhausted elements contained. 1919.

(b) Exhausted elements must be kept dry as chemical activity of wet elements may cause fire. 1919.

SPECIFICATION FOR PRIMARY BATTERY JAR.

1919.

(Official Approval May, 1920.)

1. *Designation.*

(a) Jars shall be in accordance with R.S.A. 1053. 1919.

(b) Manufacturer's identification mark shall be blown on side of each jar. 1919.

2. *Variations.*

(a) Variations shall be within the limits specified on R.S.A. 1053. 1919.

3. *Inspection.*

(a) Purchaser may inspect the material at all stages of manufacture. (S. S. 6-a.) 1919.

(b) Purchaser may inspect the completed product to determine that the requirements of this specification have been met. (S. S. 6-b.) 1919.

(c) If the material has not been accepted at point of production, and if, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected, and the Contractor, upon request, shall advise the Purchaser what disposition is to be made of the defective material. The Contractor shall pay all freight charges. (S. S. 6-c.) 1919.

(d) If Purchaser is to make inspection at point of production, it shall be so stated. (S. S. 6-d.) 1917.

4. *Tests.*

(a) Tests may be made at point of production, or on samples submitted, and may also be made at destination. (S. S. 7-a.) 1919.

(b) Contractor shall give the Purchaser sufficient notice of time when material will be ready for testing. (S. S. 7-b.) 1919.

(c) Contractor shall provide at point of production, apparatus and labor for making the required tests under supervision of the Purchaser. (S. S. 7-c.) 1919.

(d) Purchaser shall select from the proposed shipment either four (4) or twenty (20) jars for the heating and chilling test and one (1) for the solubility test. 1919.

(e) Breakage for each test shall not exceed one (1) when four (4) jars are tested or two (2) when twenty (20) jars are tested. 1919.

SPECIFICATION FOR PRIMARY BATTERY JAR.

1919

(Official Approval May, 1920.)

1. Designation.

(a) Jars shall be in accordance with R.S.A. 1919

(b) Manufacturer's identification mark shall be blown on side of each jar 1919

2. Variations.

(a) Variations shall be within the limits specified on R.S.A. 1919

3. Inspection.

(a) Purchaser may inspect the material at all stages of manufacture. (S. S. 6-a.) 1919

(b) Purchaser may inspect the completed product to determine that the requirements of this specification have been met. (S. S. 6-b.) 1919

(c) If the material has not been accepted at point of production, and if, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected, and the Contractor, upon request, shall advise the Purchaser what disposition is to be made of the defective material. The Contractor shall pay all freight charges. (S. S. 6-c.) 1919

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4. Tests.

(a) Tests may be made at point of production, or on samples submitted, and may also be made at destination. (S. S. 7-a.) 1919.

(b) Contractor shall give the Purchaser sufficient notice of time when material will be ready for testing. (S. S. 7-b.) 1919.

(c) Contractor shall provide at point of production apparatus and labor for making the required tests under supervision of the Purchaser. (S. S. 7-c.) 1919.

(d) Purchaser shall select from the proposed shipment either four (4) or twenty (20) jars for the leaking and chilling test and one (1) for the solubility test. 1919

(e) Breakage for each test shall not exceed one (1) when four (4) jars are tested or two (2) when twenty (20) jars are tested. 1919

5. *Solubility.*

(a) Expose one hundred and ten (110) square inches of inside of jar surface by filling to the required level with a solution consisting of twenty (20) grams NaOH (caustic soda) by titration in one hundred (100) c.c. of distilled water, then place in oven maintained at one hundred and twenty (120) degrees F. (49° C.) for one hundred hours. The jar shall not show a loss of weight in excess of five-tenths (.5) grams. 1919.

6. *Heating test.*

(a) Round jars having a specified wall thickness of three-sixteenths (3/16) inch, placed one-third (1/3) their depth in a mixture of crushed ice or snow and salt at five (5) degrees F. (—15° C.) for ten (10) minutes shall withstand a change in temperature due to being half filled with paraffine at three hundred and seventy-five (375) degrees F. (190° C.). Temperature shall be read with bulb of thermometer in ice and against bottom edge of jar. Round jars having a specified wall thickness of one-fourth (¼) inch shall withstand a similar test with a paraffine temperature of three hundred and forty (340) degrees F. (171° C.). 1919.

7. *Chilling test.*

(a) Round jars having a specified wall thickness of three-sixteenths (3/16) inch maintained at a temperature of two hundred and twenty-five (225) degrees F. (107° C.) for thirty (30) minutes, either in an oven or in a boiling saturated salt solution shall withstand change in temperature due to being thrust bottom downward in a tub of ice water at forty (40) degrees F. (4° C.) and then tipped over and allowed to fill. Round jars having a specified wall thickness of one-fourth (¼) inch shall withstand a similar test at a temperature of two hundred and twelve (212) degrees F. (100° C.). 1919.

8. *Packing.*

(a) Material shall be so prepared as to permit convenient handling and to protect against loss or damage during shipment. (S.S. 8-a.) 1919.

(b) Jars shall be furnished in multiples of the contents of a standard package. When not so ordered, the Manufacturer may correct the order to the nearest standard package quantity. 1919.

(c) Standard package for jars 10532 and 10533, R.S.A. 1053, shall hold eight (8) jars. 1919.

5. Solubility.

(a) Expose one hundred and ten (110) square inches of inside of jar surface by filling to the required level with a solution containing of twenty (20) grams $NaOH$ (caustic soda) by titration in one hundred (100) cc. of distilled water, then place in oven maintained at one hundred and twenty (120) degrees F. (49° C.) for one hundred hours. The jar shall not show a loss of weight in excess of five tenths (.5) grams.

6. Heating test.

(a) Round jars having a specified wall thickness of three-sixteenths (3/16) inch, placed one-third (1/3) their depth in a mixture of crushed ice or snow and salt at five (5) degrees F. (—15 C.) for ten (10) minutes shall withstand a change in temperature due to being half filled with paraffine at three hundred and seventy-five (375) degrees F. (190 C.) Temperature shall be read with bulb of thermometer in ice and against bottom edge of jar. Round jars having a specified wall thickness of one-tenth (1/10) inch shall withstand a similar test with a paraffine temperature of three hundred and forty (340) degrees F. (171° C.).

7. Chilling test.

(a) Round jars having a specified wall thickness of three-sixteenths (3/16) inch maintained at a temperature of two hundred and twenty five degrees F. (107 C.) for thirty (30) minutes, either in an oven or in a boiling saturated salt solution shall withstand change in temperature due to being thrust bottom downward in a tub of ice water at forty (40) degrees F. (4° C.) and then tipped over and allowed to fill. Round jars having a specified wall thickness of one-tenth (1/10) inch shall withstand a similar test at a temperature of two hundred and twelve (212) degrees F. (100° C.).

8. Packing.

(a) Material shall be so prepared as to permit convenient handling and to protect against loss or damage during shipment.

(b) Jars shall be furnished in multiples of the contents of a standard package. When jars are ordered, the Manufacturer to correct the order to the nearest standard package quantity.

(c) Standard packages for jars 1052, 1053, R.S.A. 1052, shall hold eight (8) jars

9. *Marking.*

(a) Purchaser's order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of package.
(S. S. 9-a.) 1919.

(b) Detail list of loose pieces, containers and their contents, shall be furnished for each shipment. Where car-load shipments are made, routing and car identification shall be shown. (S. S. 9-b.) 1919.

(c) Where car-load shipments are made, name and address of Consignee may be omitted. (S. S. 9-c.) 1919.

(x) Remarks ..... 1916.

(y) Signed ..... 1916.

(z) Date .....1916.

SPECIFICATIONS FOR HARD FIBRE.

1. *Purpose.*

This material is to be used as insulation in railroad track joints, switch rods, signal apparatus, etc.

2. *Material.*

Fibre shall be of a horny nature, made from paper containing only cotton or linen rags and shall have no water repelling substance* applied on its surface. It shall be seasoned for a period of not less than three (3) months, after being taken from the dry room. It shall be entirely free from chlorides and glycerines, as well as all other chemicals that will in any way tend to shorten its life or lower its insulating qualities under any condition of service.

3. *Specific gravity.*

Fibre shall have a specific gravity of not less than 1.3, nor more than 1.5.

4. *Flexibility.*

It must stand bending into a circle of a radius of ten (10) times its thickness without cracking or splitting. When bent to the point of rupture, it should break off square and not split.

5. *Design.*

The shape and dimension shall conform to the Purchaser's standard plans.

6. *Workmanship.*

All surfaces, where cut, shall be square and free from burrs, fins, splits and other defects. The ends and edges of all pieces shall be sawed, except holes which may be punched.

7. *Calendering.*

Fibre furnished under these specifications shall not be calendered.

8. *Electrical properties.*

Under the application of voltage for one (1) minute at the stated potentials between two (2) disc electrodes, each one (1) inch in diameter, the fibre shall not break down either by smoking, steaming, puncturing, or in any other manner fail under the voltage.

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*At the request of the Purchaser, fibre furnished assembled in and as a part of a complete article shall be coated with paraffine just prior to the assembling.

SPECIFICATIONS FOR HARD FIBRE.

1. Purpose.

This material is to be used as insulation in railroad track joints, switch rods, signal apparatus, etc.

2. Material.

Fibre shall be of a horny nature, made from paper containing only cotton or linen rags and shall have no water repelling substance* applied on its surface. It shall be seasoned for a period of not less than three (3) months, after being taken from the dry room. It shall be entirely free from chlorides and glycerines, as well as all other chemicals that will in any way tend to shorten its life or lower its insulating qualities under any condition of service.

3. Specific gravity.

Fibre shall have a specific gravity of not less than 1.2, nor more than 1.3.

4. Flexibility.

It must stand bending into a circle of a radius of ten (10) times its thickness without cracking or splitting. When bent to the point of rupture, it should break off square and not split.

5. Design.

The shape and dimension shall conform to the purchaser's standard plans.

6. Workmanship.

All surfaces, where cut, shall be square and free from burrs, fins, splits and other defects. The ends and edges of all pieces shall be sawed, except holes which may be punched.

7. Conditioning.

Fibre furnished under these specifications shall not be conditioned.

8. Electrical properties.

Under the application of voltage for one (1) minute at the stated potentials between two (2) disc electrodes, one (1) inch in diameter, the fibre shall not break down either by smoking, steaming, puncturing, or in any other manner fail under the voltage

---

*At the request of the Purchaser, fibre furnished assembled in and as a part of a complete article shall be coated with varnishing just prior to the assembling.

9. *Physical and electrical requirements.*

All fibre furnished shall meet the following requirements:

Thickness			Lbs. per square inch, tensile strength.	A.C. voltage pressure for one minute.	Per cent. of weight of sample of water absorbed at 70° F. shall not exceed for		
Nominal	Max.	Min.			3 hrs.	6 hrs.	24 hrs.
.093	.103	.082	5000	3000	18	24	57
.125	.135	.113	5000	4000	14	20	45
.156	.166	.144	5000	5000	12	17	39
.187	.197	.170	5000	6000	11	14	30
.250	.270	.230	5000	8000	9	12	26

10. *Chemical analysis.*

(a) The fibre shall be subjected to such chemical tests as may be necessary to insure that the requirements of these specifications are being complied with.

(b) A test for zinc chloride is to boil a piece of fibre in pure water for thirty (30) minutes and then add ammonia to the solution. The presence of zinc chloride is indicated by a white precipitate.

11. *Tests.*

Before tests are made, all samples shall be subjected to a temperature of seventy (70) degrees Fahr. for one week. Tests may be made at the mill or at destination, as the Purchaser elects. The Manufacturer must provide, at the mill, all apparatus and labor for making the required tests under supervision of the Purchaser.

12. *Sampling.*

For testing and inspection, one (1) piece shall be taken at random from each lot of one hundred (100) pieces or fraction thereof, and the results obtained will be taken as representing the entire shipment.

13. *Shipping.*

Fibre pieces shall be packed in such a manner that they will hold their shape and be protected from the weather and mechanical injury during shipment. Each package shall be plainly marked showing contents, name of Manufacturer, name of the consignee and order number under which furnished.

14. *Acceptance.*

If, after physical inspection of the material and in accordance with the tests, the specification is met, the material will be accepted. If any of the samples representing the material fail to meet these specifications, the shipment will be rejected and returned to the Manufacturer, who must pay all freight charges.

9. Physical and electrical requirements.

All fibre furnished shall meet the following require-

Thickness			Lbs. per square inch. Tensile strength.	A. C. voltage. Puncture in one minute.	Per cent of moisture absorbed in 24 hours. Not exceeding the following:	
Nominal.	Max.	Min.			Par.	Perp.
.031	.035	.028	3000	3000	18	24
.125	.135	.115	6000	4500	14	20
.250	.260	.240	5000	6000	12	17
.187	.197	.179	8000	6000	11	14
.250	.270	.230	7000	8000	9	12

10. Chemical analysis.

(a) The fibre shall be subjected to such chemical tests as may be necessary to insure that the requirements of these specifications are being complied with.

(b) A test for zinc chloride is to boil a piece of fibre in pure water for thirty (30) minutes and then add ammonia to the solution. The presence of zinc chloride is indicated by a white precipitate.

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Fibre pieces shall be packed in such a manner that they will hold their shape and be protected from the weather and mechanical injury during shipment. Each package shall be plainly marked showing contents, name of Manufacturer, name of the consignee and order number under which furnished.

14. Acceptance.

If, after physical inspection of the material and in accordance with the tests the specification is met, the material will be accepted. If any of the samples representing the material fail to meet these specifications the shipment will be rejected and returned to the Manufacturer, who must pay all freight charges.

GENERAL ELECTRICAL REQUIREMENTS.

1919.

(Official Approval May, 1920.)

30. *Dielectric requirements.*

(a) Unless otherwise specified, electric apparatus assembled shall withstand for one (1) minute an insulation test at place of manufacture of ..... (..) volts a.c.* between all parts of electric circuits and other metallic parts insulated therefrom. 1919.

(b) A surface leakage distance of not less than .... (..) inch* shall be provided between any exposed metallic part of the apparatus carrying current and any other metallic part thereof. 1919.

(c) Separate windings, which are insulated from each other, shall withstand for one (1) minute an insulation test of ..... (..) volts a.c.* between their terminals. 1919.

(d) A potential of twice the normal operating requirements at a suitable frequency shall be impressed across the windings without any excessive flow of current indicating a short circuit. 1919.

31. *Identification.*

(a) Magnet coils and resistance shall be plainly marked with Manufacturer's references. 1917.

32. *Insulation.*

(a) Coils and windings shall be of cotton or silk-covered wire impregnated; of enameled wire, or as shown on requisite sheet. Enameling or impregnation shall be in accordance with R.S.A. specifications. 1919.

(b) Material used for insulation shall be such as will not be injuriously affected by atmospheric conditions. 1917.

40.

This section is reserved for use in identification for electrical requirements, other than those covered by sections 30, 31 and 32.

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*Value to be given in specification for apparatus furnished in accordance therewith. 1919.

GENERAL PROVISIONS.

For use in Major Specifications.
1919.
(Official Approval May, 1920.)

1. *Purpose.*

(a) The purpose of these specifications is to provide for ..... 1915.

(b) These specifications describe the materials to be furnished, work to be performed and method of construction for a complete installation in every detail, in strict accordance with the drawings and specifications mentioned herein, and such instructions as may, from time to time, be given by the Purchaser, and it is hereby understood that the Contractor agrees to furnish any and every thing obviously necessary for such complete installation, except that specifically stated as being furnished by the Purchaser. 1915.

2. *Details of work.*

.....
.....
..... 1916.

3. *Detail and unit specifications.*

(a) Specifications referred to herein and forming an essential part hereof are as follows:.....
.....
..... 1919.

4. *Drawings.*

(a) Purchaser's drawings. Drawings accompanying the specifications and forming an essential part thereof are as follows:

1. Drawing ....., dated ....., scale one (1) inch, equals ..... (..) feet, showing the arrangement of tracks, grades, curvature, the location of interlocking stations, power stations, trunking lines, pipe lines, air reservoirs, valves, location, numbering, type, arm travel and control (R.S.A. symbols) of existing and proposed signals, location and numbering of switches, derails, switch mechanisms, detector bars, interlocking machines, steam and electric railway crossings, highway crossings, highway crossing alarms, track circuit limits, trestles, stations, station platforms, pole line or other supports for line wires or aerial cables, approximate number of poles per mile, average distance of nearest

GENERAL PROVISIONS

For use in Major Specifications

1919

(Official Approval May, 1920.)

1. Purpose.

(a) The purpose of these specifications is to provide for .....

(b) These specifications describe the materials to be furnished, work to be performed and method of construction for a complete installation in every detail, in strict accordance with the drawings and specifications mentioned hereto, and such supplements as may, from time to time, be given by the Purchaser, and it is hereby understood that the Contractor agrees to furnish any and every thing obviously necessary for such complete installation, except that specifically stated as being furnished by the Purchaser.

2. Details of work.

.....

.....

.....

3. Detail and part specifications.

(a) Specifications referred to hereto and forming an essential part thereof are as follows:

.....

.....

.....

4. Drawings.

(a) Purchaser's drawings. Drawings accompanying the specifications and form an essential part thereof are as follows:

1. Drawing ..... dated .....

one (1) inch, elpaso ..... ( ) feet, showing the arrangement of tracks, grades, curvatures, the location of interlocking stations, power stations, transmission line, pipe line, air reservoirs, valves, location, numbering, type, form (usual and control (U.S.A. symbols) of existing and proposed signals, location and numbering of switches, derails, switch mechanisms, detector bars, interlocking machines, clear and electric railway crossings, highway crossings, highway crossing alarms, track circuits, signal bridges, stations, station platforms, pole line or other supports for line wires or aerial cables, approximate number of poles per mile, average distance of nearest

4 (a-1). *Drawing.*—Continued.

pole from each signal or relay box to which line wire connections are required, notations showing the sections of rail and drilling of rail joints, and such other information as is desirable. 1916.

2. Drawing ....., dated ....., showing typical circuits for the control of power operated signals, switch indicators, protection for facing and trailing switches, main-line and siding crossovers, highway crossing alarms, train order signals and .....
..... 1911.

3. Drawing ....., dated ....., showing typical circuits for approach locking, route locking, track circuits and the control of annunciators, indicators, repeaters, and ..... 1911.

4. Drawing ....., dated ....., showing locations of battery housings, junction posts and ..... for typical signal and relay locations. 1915.

5. Standard and other drawings .....
..... 1915.

(b) Contractor's drawings.

1. The Contractor shall furnish, with his proposal, drawings or catalogue references for the apparatus he proposes to furnish, which is not covered by the drawings furnished by the Purchaser. 1911.

2. Not more than ..... (..) days after the award of the contract, and before work is begun, the Contractor shall furnish, for the approval of the Purchaser, the following drawings:.....
.....
.....
Not more than ..... (..) days after the receipt of these drawings the Purchaser will indicate any corrections that may be necessary or signify his approval. 1915.

(c) After the contract is awarded, each party shall furnish to the other necessary prints of his approved drawings. 1915.

(d) Framed manipulation chart and track diagram shall be furnished in place by the ..... 1915.

4 (201). Drawing.—Continued

5. *Proposals.*

(a) With his proposal the Contractor shall submit supplemental specifications, stating his interpretation of the specification requirements. 1916.

(b) The proposals must meet the requirements of the specification; however, if a bidder wishes to vary from the specifications or drawings, an alternative proposal may be submitted. Full information must be furnished with the alternative proposal to show wherein the requirements of these specifications are varied from. 1919.

6. *Contract.*

(a) As soon as practicable after the award is made .... (..) copies of the contract, in accordance with the accompanying form, will be presented to the Contractor for signature, after which all copies will be signed by the Purchaser and two will be returned to the Contractor. 1919.

7. *Changes and additions.*

(a) Changes and additions, as provided for in the contract, shall be made in accordance with the specifications. 1911.

(b) Additional work within the scope of the contract shall be done on the basis of the unit prices as stated in the contract. 1911.

8. *Material and workmanship.*

(a) Material and workmanship shall be first-class in every respect. 1911.

9. *Furnished by the Purchaser.*

(a) The Purchaser will furnish material and labor on items in 9-c, as follows:

1. Material only .....
..... 1915.
2. Labor only .....
..... 1915.
3. Material and labor.....
..... 1915.

(b) The Purchaser will furnish the items indicated above, subject to the inspection of the Contractor, who shall state any objections thereto before starting his part of the work. After rectification by the Purchaser of any defects reported, the Contractor shall assume full responsibility for the proper functioning of the installation. The intent of this section is to bar any claim by the Contractor that the work done by the Purchaser has not

5. Proposals.

(a) With his proposal the Contractor shall submit complemental specifications, stating his interpretation of the specification requirements.

(b) The proposals must meet the requirements of the specifications; however if a bidder wishes to vary from the specifications or drawings, an alternate proposal may be submitted. Full information must be furnished with the alternative proposal to show wherein the requirements of these specifications are varied from

6. Contract.

(a) As soon as practicable after the award is made . . .

. . . . . (c) Copies of the contract, in accordance with the accompanying form, will be presented to the Contractor for signature, after which all copies will be signed by the Purchaser and two will be returned to the Contractor.

7. Changes and additions.

(a) Changes and additions, as provided for in the contract shall be made in accordance with the specifications.

(b) Additional work within the scope of the contract shall be done on the basis of the unit prices as stated in the contract.

8. Material and workmanship.

(a) Material and workmanship shall be [illegible] in every respect.

9. Furnished by the Purchaser.

(a) The Purchaser will furnish material and labor on items in part as follows:

1. Material only . . . . . .

. 1913

2. Labor only 1913

. 1913

3. Material and labor 1913

. 1913

(b) The Purchaser will furnish the items indicated above, subject to the inspection of the Contractor, who shall make any objections thereto before starting his part of the work. After rectification by the Purchaser of any defects reported, the Contractor shall assume full responsibility for the proper functioning of the installation. The intent of this section is to bar any claim by the Contractor that the work done by the Purchaser has not

9. *Furnished by the Purchaser.*—Continued.

been performed in such manner as to enable him to fulfill all of the provisions of the contract. 1919.

(c) Items.

1. Ties for support of apparatus. 1915.
2. Move ties as may be necessary. 1915.
3. Move switch and tie rods as may be necessary. 1915.
4. Rail insulations. 1915.
5. Bridge insulations. 1915.
6. Switch-rod insulations. 1915.
7. Tie-rod insulations. 1915.
8. Tie-plate insulations. 1915.
9. Sand, stone and cement. 1915.
10. Necessary grading and drainage. 1915.
11. Excavation of solid rock. 1915.
12. Poles for line wire. 1915.
13. Cross arms, pins and insulators. 1915.
14. Line wire. 1915.
15. Battery wells. 1915.
16. Signal bridges. 1915.
17. Aerial cable. 1915.
18. Submarine cable. 1915.
19. Apply necessary attachments to signal apparatus in service. 1915.
20. Make necessary alterations of any part of existing structures or apparatus. 1915.
21. Unload and properly house material that arrives on the ground before the Contractor's force; this work to be done under the supervision of the Contractor's representative. 1916.
22. Distribute material. 1915.
23. Obtain necessary permits from Federal, State and Municipal authorities. 1915.
24. Switches, derails and movable point frogs of the required throw. 1915.
25. Tools, fixtures for buildings and supplies required for the maintenance of the plant. 1915.
26. Rail braces, except those located on tie plates installed by the Contractor. 1915.
27. Remove obstructions to permit the installation of detector bars. 1915.
28. Submarine air pipe line. 1915.

6. Furnished by the Purchaser.—Continued.

(c) Items.

1. Ties for support of apparatus.
2. Move ties as may be necessary.
3. Move switch and ties as may be necessary.
4. Rail insulations.
5. Bridge insulations.
6. Switch-rod insulations.
7. Tie-rod insulations.
8. Tie-plate insulations.
9. Sand, stone and cement.
10. Necessary grading and drainage.
11. Excavation of solid rock.
12. Poles for line wire.
13. Cross arms, pins and insulators.
14. Line wire.
15. Battery wells.
16. Signal bridges.
17. Aerial cable.
18. Submarine cable.
19. Apply necessary attachments to signal apparatus in service.
20. Make necessary alterations of any part of existing structures to apparatus.
21. Unload and properly house material that arrives on the ground before the Contractor's force; this work to be done under the supervision of the Contractor's representative.
22. Distribute material.
23. Obtain necessary permits from Federal, State and Municipal authorities.
24. Switches, derails and movable point frogs of the required throw.
25. Tools, fixtures for buildings and supplies required for the maintenance of the plant.
26. Rail braces, except those located on the plates installed by the Contractor.
27. Remove obstructions to permit the installation of detector bars.
28. Submarine air pipe line.

9. (c). *Furnished by the Purchaser.*—Continued.

29. Prior to installation, furnish stakes establishing grade of track at points where pipe lines are to be run. 1916.

10. *Inspection of material.*

(a) Material at any time before installation shall be subject to the inspection of the Purchaser's accredited representative. 1911.

11. *Shipment of material.*

(a) Material shall be shipped to ..... care of ....., marked for ..... Material shipped from Contractor's factory at ..... shall be shipped via ..... and thence via ..... to destination. 1911.

12. *Transportation.*

(a) The Purchaser { will / will not } furnish transportation for men, necessary for the installation, over the following lines .....
..... 1915.

(b) The Purchaser { will / will not } furnish transportation for tools and material, necessary for the installation, over the following lines .....
..... 1915.

13. *Supervision.*

(a) The installation shall be made under the supervision of the Purchaser's accredited representative. 1919.

14. *Inspection of installation.*

(a) The Contractor shall advise the Purchaser ..... (..) days in advance of the time the installation will be completed and ready for final inspection. The Purchaser will make inspection and tests within ..... (..) days after the completion of the work. 1915.

15. *Precautions.*

(a) The Contractor shall place sufficient and proper guards for the prevention of accidents, and shall put and maintain, at night, suitable and sufficient lights, as prescribed by the Purchaser. 1919.

(b) The Contractor shall do no work that may interfere with traffic until protection has been provided by the Purchaser. 1911.

9. (c) Furnished by the Purchaser.--Continued

(g) Prior to installation, furnish switch ramplights and graded track at points where pipe lines are to be run.

10. Inspection of material.

(a) Material at any time before installation shall be subject to the inspection of the Purchaser's accredited representative.

11. Shipment of material.

(a) Material shall be shipped to ..... care of ..... , marked for ..... Material shipped from Contractor's factory at ..... shall be shipped via ..... and thence via ..... to destination

12. Transportation.

(a) The Purchaser { will / will not } furnish transportation for men, necessary for the installation, over the following lines .....

(b) The Purchaser { will / will not } furnish transportation for tools and material, necessary for the installation, over the following lines .....

13. Supervision.

(a) The installation shall be made under the supervision of the Purchaser's accredited representative.

14. Inspection of installation.

(a) The Contractor shall advise the Purchaser ..... ( ) days in advance of the time the installation will be completed and ready for final inspection. The Purchaser will make inspection and test within ..... ( ) days after the completion of the work.

15. Precaution.

(a) The Contractor shall place sufficient and proper guards for the prevention of accidents, and shall put and maintain, at night, suitable and sufficient lights, as prescribed by the Purchaser.

(b) The Contractor shall do no work that may interfere with traffic until protection has been provided by the Purchaser.

15. *Precautions.*—Continued.

(c) The Purchaser will promptly arrange to protect traffic upon request of the Contractor. 1911.

16. *Use of hand and other cars.*

(a) The use of the following cars will be permitted and the Purchaser's regulations for their operation are made a part of this specification:

	Number	Furnished by
Motor cars	(..)	.....
Velocipede cars	(..)	.....
Hand cars	(..)	.....
Push cars	(..)	.....

1919.

(b) When the Contractor is not permitted to use cars, the Purchaser will distribute material, under the supervision of the Contractor's representative. 1916.

17. *Tests.*

(a) The Contractor shall make such tests as may be necessary to demonstrate, to the satisfaction of the Purchaser, that the apparatus, as installed, is in accordance with the requirements of the specifications and contract. The Contractor shall provide such instruments and apparatus as may be necessary for making the tests. The instruments and apparatus shall remain the property of the Contractor. 1916.

18. *Placing in service.*

(a) After receipt of written authority from the Purchaser, the Contractor shall place the installation in service under the supervision of the Purchaser, and shall leave ..... (..) competent men on duty for ..... (..) days thereafter. 1911.

(b) The Purchaser will place the installation in service in the event that he does not authorize the Contractor to do so within ..... (..) days after the completion of the work to the Purchaser's satisfaction. 1915.

(c) Signal aspects shall be displayed or changed only as authorized by the Purchaser. 1916.

19. *Completion.*

(a) When the installation is completed, the apparatus and the surface of the ground which has been affected by the installation, shall be left in a neat and clean condition. 1911.

15. Precautions—Continued.

(c) The Purchaser will promptly arrange to protect traffic upon request of the Contractor. (par.

16. Use of hand and other cars.

(a) The use of the following cars will be permitted and the Purchaser's regulations for their operation are made a part of this specification:

Number	Furnished by
Motor cars	( ) .....
Velocipede cars	( ) .....
Hand cars	( ) .....
Push cars	( ) .....

(par.

(b) When the Contractor is not permitted to use cars, the Purchaser will distribute material, under the supervision of the Contractor's representative. (par.

17. Tests.

(a) The Contractor shall make such tests as may be necessary to demonstrate, to the satisfaction of the Purchaser, that the apparatus, as installed, is in accordance with the requirements of the specifications and contract. The Contractor shall provide such instruments and apparatus as may be necessary for making the tests. The instruments and apparatus shall remain the property of the Contractor. (par.

18. Placing in service.

(a) After receipt of written authority from the Purchaser, the Contractor shall place the installation in service under the supervision of the Purchaser, and shall leave ..... (...) consecutive days on duty for ..... (...) days thereafter. (par.

(b) The Purchaser will place the installation in service in the event that he does not authorize the Contractor to do so within ..... (...) days after the completion of the work to the Purchaser's satisfaction. (par.

(c) Signal aspects shall be displayed or changed only as authorized by the Purchaser. (par.

19. Completion.

(a) When the installation is completed, the apparatus and the surface of the ground which has been affected by the installation shall be left in a neat and clean condition. (par.

20. *Warranty.*

(a) The Contractor shall replace, at his own cost, any part or parts of the apparatus and material furnished by him, which shall, within a period of one (1) year from date of acceptance of the installation, fail to perform its proper function because of any defect in the design, construction, application, or erection of such apparatus.

1919.

General Provisions 1910.

20. Warranty.

(a) The Contractor shall replace, at his own cost, any part or parts of the apparatus and material furnished by him, which shall, within a period of one (1) year from date of acceptance of the installation, fail to perform its proper function because of any defect in the design, construction, application, or erection of such apparatus

SPECIFICATION FOR IMPEDANCE BOND.

1919.

(Official Approval May, 1920.)

1. *Requisite sheet.*

(a) Requisite sheet, section 17, attached to this specification, shall form a part thereof. (S. S. 4-a.) 1919.

(b) Where blanks have not been filled, or where an option is permitted and no preference stated, the Contractor's recommended practice shall be followed. (S. S. 4-b.) 1919.

2. *Tender.*

(a) The tender shall be for apparatus meeting the requirements of this specification. If the Contractor wishes to vary from the specification, a tender may be submitted covering the apparatus he desires to furnish. This tender shall be accompanied by full information showing wherein the requirements of the specification are varied from. (S. S. 3-a.) 1919.

3. *Design.*

(a) The impedance bond shall be of a design approved by the Purchaser. 1917.

(b) The case and cover shall be of cast iron, and weather-proof. The lugs on the case to be located so that the impedance bond can be supported between ties or located on a foundation as specified on requisite sheet. 1919.

(c) The case and cover shall be so constructed that protection will be afforded against loss of the cooling medium at temperature corresponding to the rated capacity of the bond. 1919.

(d) The length and size of cables shall be as shown on requisite sheet. 1919.

(e) Bond terminals shall be furnished with bonds. They shall be of such design as to take the cables specified on requisite sheet. 1919.

4. *Air gap.*

(a) When the bond has an air gap in its magnetic circuit, it shall be so designed that the air gap may be varied by varying the thickness of the air gap spacers. 1917.

5. *Petrolatum or transformer oil.*

(a) If furnished with the bond, shall be as specified on requisite sheet. 1919.

(b) If furnished, shall be sufficient to fill the bond case to a line which shall be indicated by the Manufacturer to designate the oil or petrolatum level. 1919.

SPECIFICATION FOR IMPEDANCE BOND

1919.

(Official Approval May, 1920.)

1. Requisite sheet.

(a) Requisite sheet, section 17, attached to this specification, shall form a part thereof. (S. S. 4-a.) 1919.

(b) Where blanks have not been filled, or where an option is permitted and no preference stated, the Contractor's recommended practice shall be followed.

(S. S. 4-b.) 1919

2. Tender.

(a) The tender shall be for apparatus meeting the requirements of this specification. If the Contractor wishes to vary from the specification, a tender may be submitted covering the apparatus he desires to furnish. This tender shall be accompanied by full information showing wherein the requirements of the specification are varied from. (S. S. 3-a.) 1919.

3. Design.

(a) The impedance bond shall be of a design approved by the Purchaser. 1919.

(b) The case and cover shall be of cast iron, and weather-proof. The lugs on the case to be located so that the impedance bond can be supported between ties or located as a combination as specified on requisite sheet.

1919

(a) The case and cover shall be so constructed that protection will be afforded against loss of the coating medium at temperatures corresponding to the rated capacity of the bond 1919

(d) The length and size of cables shall be as shown on requisite sheet. 1919

(e) Bond terminals shall be furnished with bonds. They shall be of such design as to take the cables specified on requisite sheet. 1919.

4. Air gap.

(a) When the bond has an air gap in its magnetic circuit, it shall be so designed that the air gap may be varied by varying the thickness of the air gap spacers.

1919

5. Petrolatum or transformer oil.

(a) If furnished with the bond, shall be as specified on requisite sheet. 1919.

(b) If furnished, shall be sufficient to fill the bond case to a line which shall be indicated by the Manufacturer to designate the oil of petrolatum level. 1919

6. *Dielectric requirements.*

(b) A surface leakage distance of not less than one-fourth (¼) inch shall be provided between any exposed metallic part of the apparatus carrying current and any other metallic part thereof. (G. E. R. 30-b.) 1919.

(e) Separate windings which are insulated from each other shall withstand a potential test of five hundred (500) volts a.c. for one (1) minute between their terminals. All windings shall withstand a high potential test of two thousand (2000) volts a.c. for one (1) minute between their terminals and other metal parts from which these windings are insulated. 1919.

7. *Insulation.*

(b) Material used for insulation shall be such as will not be injuriously affected by atmospheric conditions. (G. E. R. 32-b.) 1917.

8. *Capacity.*

(a) The capacity of the bonds shall be as specified on requisite sheet. 1919.

(b) Bonds intended for direct current propulsion shall be so designed that the propulsion current in one-half (½) the winding may exceed that in the other half by twenty (20) per cent. of the total (two rail) continuous capacity of the bonds without the impedance decreasing more than ten (10) per cent. at the stated impressed signal voltage. 1917.

9. *Temperature rise.*

(a) The temperature rise for capacities at duration stated on requisite sheet shall not exceed seventy-five (75) degrees C. (167° F.) based upon a room temperature of twenty (20) degrees C. (68° F.). 1919.

(b) The temperature rise shall be determined by the resistance method. Thermometer readings shall also be taken in the cooling medium and on the coils, core and case. The highest reading obtained shall be used in determining temperature rise. 1919.

(c) Tests for intermittent ratings to be started at approximately room temperature. 1919.

10. *Resistance.*

(a) The ohmic resistance of the bond shall be as stated on requisite sheet. 1919.

(b) This measurement shall be taken at room temperature and corrected to a standard temperature of twenty (20) degrees C. (68° F.). The temperature of the coil shall be carefully determined by a thermometer. 1919.

(c) This measurement shall be taken between the ter-

10-c. *Resistance.*—Continued.

minals of the coil and shall not include the cables from the bond. 1917.

11. *Name-plate.*

(a) A metal name-plate shall be attached to the bond cover, so that it can be readily seen when the bond is in place. This plate shall contain the following information:

1. Name of Manufacturer.
2. Drawing or specification reference.
3. Serial number.
4. Impedance in ohms at a stated impressed voltage and frequency.
5. Continuous capacity in amperes per rail.
6. Ohms resistance. 1917.

12. *Inspection.*

(a) Purchaser may inspect the material at all stages of manufacture. (S. S. 6-a.) 1919.

(b) Purchaser may inspect the completed product to determine that the requirements of this specification have been met. (S. S. 6-b.) 1919.

(c) If the material has not been accepted at point of production, and if, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected, and the Contractor, upon request, shall advise the Purchaser what disposition is to be made of the defective material. The Contractor shall pay all freight charges. (S. S. 6-c.) 1919.

(d) If Purchaser is to make inspection at point of production, it shall be so stated. (S. S. 6-d.) 1919.

13. *Tests.*

(b) Contractor shall give the Purchaser sufficient notice of time when material will be ready for testing. (S. S. 7-a.) 1919.

(c) Contractor shall provide, at point of production, apparatus and labor for making the required tests under supervision of the Purchaser. (S. S. 7-c.) 1919.

(d) The impedance and ohmic resistance of the bonds shall not vary more than fifteen (15) per cent. above or below the values specified. 1917.

(e) The power factor of the bonds shall not vary from the specified value by more than twenty-five (25) per cent. of said value. 1917.

(f) All bonds shall be subjected to tests to determine:

1. Impedance at rated voltage and frequency, using sine wave e.m.f.
2. Insulation. 1917.

10-c. Resistance.—Continued.

minals of the coil and shall not include the cables from the bond.

11. Name-plate.

(a) A metal name-plate shall be attached to the bond cover, so that it can be readily seen when the bond is in place. This plate shall contain the following information:

1. Name of Manufacturer.
2. Drawing or specification reference.
3. Serial number.
4. Impedance in ohms at a stated impressed voltage and frequency.
5. Continuous capacity in amperes per rail.
6. Ohms resistance.

12. Inspection.

(a) Purchaser may inspect the material at all stages of manufacture.

(b) Purchaser may inspect the complete product to determine that the requirements of this specification have been met.

(c) If the material has not been accepted at point of production, and if, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected, and the Contractor, upon request, shall advise the Purchaser what disposition is to be made of the defective material. The Contractor shall pay all freight charges.

(d) If Purchaser is to make inspection at point of production, it shall be so stated.

13. Tests.

(b) Contractor shall give the Purchaser sufficient notice of time when material will be ready for testing.

(c) Contractor shall provide at point of production, apparatus and labor for testing the required tests under supervision of the Purchaser.

(d) The impedance and ohmic resistance of the bonds shall not vary more than fifteen (15) per cent above or below the values specified.

(e) The power factor of the bonds shall not vary from the specified value by more than twenty-five (25) per cent. of said value.

(i) All bonds shall be subjected to tests to determine:

1. Impedance at rated voltage and frequency.
2. Insulation
using sine wave emf.

13. *Tests.*—Continued.

(g) The following test shall be made on the first two (2) bonds of new characteristics:

1. Ohmic resistance.
2. Power factor at rated voltage.
3. Variation in impedance with variation in impressed voltage at signaling frequency and specified air gap. 1917.

14. *Packing.*

(a) Material shall be so prepared as to permit convenient handling and to protect against loss or damage during shipment. (S. S. 8-a.) 1919.

15. *Marking.*

(a) Purchaser's order, requisition and package number, name of Consignor and name and address of Consignee, shall be plainly marked on outside of package. (S. S. 9-a.) 1919.

(b) Detail list of loose pieces, containers and their contents, shall be furnished for each shipment. Where car-load shipments are made, routing and car identification shall be shown. (S. S. 9-b.) 1919.

(c) Where car-load shipments are made, name and address of Consignee may be omitted. (S. S. 9-c.) 1919.

16. *Warranty.*

(a) Contactor shall warrant the material covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to making, at point of production, any part or parts to replace those which shall be found effective, within one (1) year after shipment to the Purchaser. This warranty shall not apply to any apparatus which shall have been repaired or altered in any way by anyone other than the Manufacturer thereof so as to, in the Contractor's judgment, affect its proper functioning or reliability, nor which has been subject to misuse, negligence or accident. (S. S. 10-a.) 1919.

17. *Requisites for impedance bond, A. R. A. specification.*

(a) Purchaser to fill in such items as he desires to specify. Contractor to fill in all other blanks, so that the requisite sheet will be complete when finally submitted with Contractor's quotation. 1919.

(b) Identification.

Impedance bonds covered by this sheet are for..... ..... Railroad on Inquiry ....., Order ....., Requisition ..... 1917.

13. Tests.—Continued.

(g) The following test shall be made on the first two

(a) bonds of new characteristics:

1. Ohmic resistance.

2. Power factor at rated voltage.

3. Variation in impedance with variation in impressed voltage at signaling frequency and specified air gap. 1917.

14. Packing.

(a) Material shall be so prepared as to permit convenient handling and to protect against loss or damage during shipment (S. S. 8-a.) 1919

15. Marking.

(a) Purchaser's order, requisition and package number, name of Consignor and name and address of Consignee, shall be plainly marked on outside of package. (S. S. 9-a.) 1919

(b) Detail list of loose pieces, contained and their contents, shall be furnished for each shipment. Where car-load shipments are made, routing and car identification shall be shown (S. S. 9-b.) 1919.

(c) Where car-load shipments are made, name and address of Consignee may be omitted. (S. S. 9-c.) 1919

16. Warranty.

(a) Contractor shall warrant the material covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to making, or paying for production, any part or parts to replace those which shall be found effective, within one (1) year after shipment to the Purchaser. This warranty shall not apply to any apparatus which shall have been repaired or altered in any way by anyone other than the Manufacturer thereof so as to, in the Contractor's judgment, affect its proper functioning or reliability, nor which has been subject to misuse, negligence or accident.

(S. S. 10-a.) 1919.

17 Requisites for impedance bond, A. R. A. specification.

(a) Purchaser to fill in such items as he desires to specify. Contractor to fill in all other blanks, so that the requisite sheet will be complete when finally submitted with Contractor's quotation. 1919

(b) Identification.

Impedance bonds covered by this sheet are for.....

..... Railroad on Inquiry ...., Order

....., Requisition ..... 1919.

17. *Requisites for impedance bonds, A. R. A. specification.*—Con.

(c) Impedance bonds to be furnished in accordance with the following drawings .....
1917.

(d) Characteristics.

1. Number of each type of bond required .....
2. Manufacturer's name .....
3. Catalogue or drawing reference .....
4. Frequency of signaling currents ..... cycles.
5. Bonds to be { Single type ..... / Double type ..... }
6. Impedance of bond — Ohms at volts
   ....
   ....
7. Normal air gap per side in magnetic circuit .....
8. Traction current { d.c. at ..... volts / a.c. ..... cycles / at ..... volts }
9. *Ohmic resistance of complete coil at 20 degrees C. (68° F.) ..... ohms.
10. Capacity of bonds Amperes per rail { Continuous ..... amps. / Intermittent { .....amps. for 2 hrs. / .....amps. for 10 min. / .....amps. for 5 secs. } }
11. Cooling medium of bond { Air ..... / Oil ..... / Petrolatum ..... }
12. Oil or petrolatum to be furnished by .....
13. Oil or petrolatum shall be in accordance with { R. S. A. Specification. / ..... Specification. }
14. Location of bonds { on foundation ..... / between ties and rails.... / beside track..... }

*Measurement to be made between leads where they leave the bond case.

19. Requisites for impedance bonds, A. R. A. specification.—Con.

(c) Impedance bonds to be furnished in accordance with the following drawings .....

(d) Characteristics.

1. Number of each type of bond required .....
2. Manufacturer's name .....
3. Catalogue or drawing reference .....
4. Frequency of signaling currents ..... cycles
5. Bonds to be { Single type .....
Double type .....
6. Impedance of bond { Ohms at volts
.....
.....
7. Normal air gap per side in magnetic circuit .....
8. Traction current { d.c. at ..... volts
a.c. ..... cycles
at ..... volts
9. *Ohmic resistance of complete coil at 20 degrees C (68° F.) ..... ohms.
10. Capacity of bonds Amperes per rail { Continuous ..... amps.
Intermittent { for 1 hr. ..... amps.
for 30 min. ..... amps.
for 3 secs. .....
11. Cooling medium of bond { Air .....
Oil .....
Petrolatum .....
12. Oil or petrolatum to be furnished by .....
13. Oil or petrolatum shall be in accordance with { R. S. A. Specification.
..... Specification
14. Location of bonds { on foundation .....
between ties and rails .....
Inside track .....

*Measurement to be made between leads where they leave the bond case.

17-d. *Requisites for impedance bond, A. R. A. specification.*—Con.

15. Cables from bond
- No. of conductors .....
- No. of strands in each conductor .....
- Length .....ft.
- Cross section .....C.M.
- To be furnished by .....

16. Cables for neutral point of bond
- No. of conductors .....
- No. of strands in each conductor .....
- Length ..... ft.
- Cross section ..... C.M.
- To be furnished by .....

17. Cables for cross bonding
- No. of conductors .....
- No. of strands in each conductor .....
- Length ..... ft.
- Cross section ..... C.M.
- To be furnished by .....

18. Cables
- Bare .....
- Insulated .....
- Tinned .....
- Untinned .....

19. Rail terminals
- Compressed type .....
- Expanded type .....
- Catalogue or dwg. reference .....
- Number per bond.....
- To be furnished by .....

20. Terminals for cross bonding
- To be designed for .....Cables each...C.M. and .....Cables each...C.M.
- Catalogue or dwg. reference .....
- To be furnished by .....

1919.

(e) Bolts or lag screws to be furnished by .....

1919.

17-d. Requisites for impedance bond, A. R. A. specifications—Con.

15. Cables from bond
- No. of conductors
- No. of strands in each conductor
- Length ..... ft.
- Cross section ..... C.M.
- To be furnished by ....

16. Cables for neutral point of bond
- No. of conductors
- No. of strands in each conductor
- Length ..... ft.
- Cross section ... C.M.
- To be furnished by ....

17. Cables for cross bonding
- No. of conductors
- No. of strands in each conductor
- Length ..... ft.
- Cross section ..... C.M.
- To be furnished by ....

18. Cables
- Bare
- Insulated
- Tinned
- Untinned

19. Rail terminals
- Compressed type
- Expanded type
- Catalogue or dwg. reference .....
- Number per bond..
- To be furnished by ....

20. Terminals for cross bonding

To be designed for
- .... Cables each.. C.M. and ..... Cables each... C.M.

Catalogue or dwg. reference .....
To be furnished by .....

(e) Bolts or lag screws to be furnished by .....

17. *Requisites for impedance bond, A. R. A. specification.*—Con.

(f) Special requisites .....
.....
.....
.....
.....
1919.

(g) Weight.

1. Total net weight .....
2. Total shipping weight .....

1919.

(h) Inspection or tests.

1. Shall inspection or tests be made at points of production under supervision of Purchaser? ..... 1917.
2. ..... days' notice required by Purchaser before apparatus will be ready for inspection or tests? 1916.
3. Shall inspections or tests be made at destination by Purchaser? ..... 1918.
4. Shall record of inspection and tests as furnished by Contractor be accepted? .....

1919.

(x) Remarks .....
.....
.....
.....
1916.

(y) Signed ..... 1916.

(z) Date ..... 1916.

REQUISITES FOR MECHANICAL INTERLOCKING MACHINE.

1919.

(Official Approval May, 1920.)

1. Machine is for ..... R. R., to be located at ..... on inquiry ..... order ..... requisition ..... dated ..... 1919.

2. Machine shall be in accordance with A.R.A. specification for ..... machine. 1919.

3. Machine shall be arranged for { vertical / horizontal } leadout. 1919.

4. Machine shall have ..... working levers ..... spare levers ..... spare space, total ..... 1919.

5. ..... two-position levers.

6. .....three-position levers.

7. .....-way locking brackets shall be furnished. 1919.

8. .....-way locking bed shall be furnished. 1919.

9. Levers Nos. ..... shall be equipped with counterweights of ..... pounds to assist in moving to the normal position. 1919.

10. Levers Nos. ..... shall be equipped with counterweight of ..... pounds to assist in moving them to the reverse position. 1919.

11. Levers shall be numbered and arranged in accordance with track and signal plan* number ..... dated ..... 1919.

---

*Track and signal plan should have all main, side and auxiliary tracks properly designated, direction of traffic and routing of signals indicated. 1919.

American Railroad Association.
Signal Division.

REQUISITES FOR MECHANICAL INTERLOCKING MACHINE.

1919.

(Official Approval May, 1920.)

1. Machine is for ..... R. R. to be located at ..... on inquiry ..... order .....
requisition ..... dated ..... 1919.

2. Machine shall be in accordance with A.R.A. specification for ..... machine. 1919.

3. Machine shall be arranged for { vertical / horizontal } leading. 1919.

4. Machine shall have ..... working levers ..... spare levers ..... spare spaces total ..... 1919.

5. ..... two-position levers.

6. ..... three-position levers.

7. ..... -way locking brackets shall be furnished. 1919.

8. ..... -way locking bed shall be furnished 1919.

9. Levers Nos. ..... shall be equipped with counterweights of ..... pounds to assist in moving to the normal position. 1919.

10. Levers Nos. ..... shall be equipped with counterweights of ..... pounds to assist in moving them to the reverse position. 1919.

11. Levers shall be numbered and arranged in accordance with track and signal plan* number ..... dated ..... 1919.

---

*Track and signal plan should have all main side and auxiliary tracks properly designated, direction of trains and routing of signals indicated 1919.

SPECIFICATION FOR MECHANICAL INTERLOCKING MACHINE, IMPROVED SAXBY AND FARMER LOCKING.

1919.

(Official Approval May, 1920.)

1. *Requisite sheet.*

(a) Requisite sheet, section 14, attached to this specification, shall form a part thereof. (S. S. 4-a.) 1919.

(b) Where blanks have not been filled, or where an option is permitted and no preference stated, the Contractor's recommended practice shall be followed. (S. S. 4-b.) 1919.

2. *General.*

(a) Levers shall be numbered from left to right. 1916.

(b) Track and signal plan, locking and dog sheets shall be approved by the Purchaser. 1919.

(c) Machine legs, bottom girders, lever shoes, quadrants, top plates, rocker links, back, front and intermediate rails, end blocks, universal links, bearings, end strips, counter-weights and locking brackets shall be made of cast iron. 1919.

(d) Latch shoes, latch blocks, latch handles, latch nuts, combined lever number and foot plates, drivers for end of locking shafts, locking shaft drivers for longitudinal locking bars, bottom girder caps and driving pieces for longitudinal locking bars, shall be made of malleable iron. 1919.

(e) Levers, tail levers, latch rods and locking bracket caps shall be made of open hearth steel. 1919.

(f) Locking shafts, longitudinal locking bars, cross locking, locking dogs and stops, driving piece blocks and all pins shall be made of cold drawn steel. 1919.

(g) Swing locking dogs shall be made of malleable iron or steel. 1919.

(h) Latch springs shall be made of spring steel wire. 1919.

(i) Trunnions shall be made of forged steel. 1919.

(j) Machine shall consist of one, four and eight-lever sections. 1919.

(k) On machines having four or one-lever sections, the four-lever section shall be placed on the right hand end of the machine; one-lever section may be placed on either end of the machine. 1919.

American Railroad Association.
Signal Division.

SPECIFICATION FOR MECHANICAL INTERLOCKING MACHINE, IMPROVED SAXBY AND FARMER LOCKING.

1919.

(Official Approval May, 1920.)

1. Requisite sheet.

(a) Requisite sheet, section 14, attached to this specification, shall form a part thereof. (S. S 4-a.) 1919.

(b) Where blanks have not been filled, or where an option is permitted and no preference stated, the Contractor's recommended practice shall be followed. (S. S. 4-b.) 1919.

2. General.

(a) Levers shall be numbered from left to right. 1919.

(b) Track and signal plan, locking and dog sheets shall be approved by the Purchaser. 1919.

(c) Machine legs, bottom girders, lever shoes, quadrants, top plates, rocker links, back, front and intermediate rails, end blocks, universal links, bearings, end strips, counter-weights and locking brackets shall be made of cast iron. 1919.

(d) Latch shoes, latch blocks, latch handles, latch nuts, combined lever number and foot plates, drivers for end of locking bars, locking shaft drivers for longitudinal locking bars, bottom girder cage and driving pieces for longitudinal locking bars, shall be made of malleable iron. 1919.

(e) Levers, rail levers, latch rods and locking bracket caps shall be made of open hearth steel. 1919.

(f) Locking spools, longitudinal locking bars, cross locking, locking dogs and stops, driving piece blocks and all pins shall be made of cold drawn steel. 1919.

(g) Swing locking dogs shall be made of malleable iron or steel. 1919

(h) Latch springs shall be made of spring steel wire. 1919.

(i) Trunnions shall be made of forged steel. 1919

(j) Machine shall consist of one, four and eight-lever sections. 1919.

(k) On machines having four or one-lever sections, the four-lever section shall be placed on the right hand end of the machine; one-lever section may be placed on either end of the machine. 1919.

2. *General.*—Continued.

(l) Levers shall be spaced five (5) inches center to center. 1919.

(m) Height of machine for vertical leadout shall be two (2) feet, eight and one-eighth (8⅛) inches from bottom of leg to finished top of top plate. 1919.

(n) Height of machine for horizontal leadout shall be three (3) feet, five and seven-eighths (5⅞) inches from bottom of leg to finished top of top plate. 1919.

(o) Like part of same Manufacturer's machine shall be interchangeable. 1919.

(p) Each spare space shall be equipped with cap and pin for lever shoe. 1919.

(q) Bolts and screws shall have U. S. standard threads, unless otherwise specified. 1919.

(r) Nuts, bolts and cap screw heads shall be hexagonal, unless otherwise specified. 1919.

(s) Bolts and cap screws, except for locking caps, shall be provided with spring lock washers where practicable. 1919.

(t) Taper dowel pin shall be No. 8 standard Morse taper two (2) inches in length. 1919.

(u) Straight dowel pins shall be one-fourth (¼) inch diameter. 1919.

(v) When necessary to hold parts in fixed relation to each other, dowel pins or body-bound bolts shall be used. 1919.

(w) Moving parts of machine shall work freely, without lost motion. 1919.

(x) Machine shall be painted in accordance with R. S. A. specification for shop painting. 1919.

(y) All parts of machines shipped knocked-down shall be marked with steel figures on a finished surface and given the numbers which they take in the assembled machine. 1919.

(z) Locking brackets, cross locking, longitudinal locking and swing dogs shall be marked to read from back of machine. Longitudinal bars shall have their lever numbers marked directly over their drivers. Swing dogs shall be marked with lever number at trunion end and space number at nose end. 1919.

3. *Machine legs.*

(a) Legs for vertical leadout machine shall be two (2) feet seven and one-fourth (7¼) inches in height and base of leg shall be provided with four (4) holes for three-fourths (¾) inch bolts. 1919.

2. General.—Continued

(l) Levers shall be spaced five (5) inches center to center.

(m) Height of machine for vertical locknut shall be two (2) feet, eight and one-eighth (8⅛) inches from bottom of leg to finished top of top plate. 1919.

(n) Height of machine for horizontal locknut shall be three (3) feet, five and seven-eighths (5⅞) inches from bottom of leg to finished top of top plate. 1919.

(o) Like part of same Manufacturer's machine shall be interchangeable. 1919.

(p) Each spare space shall be equipped with cap and pin for lever shoe. 1919.

(q) Bolts and screws shall have U. S. standard threads, unless otherwise specified. 1919.

(r) Nuts, bolts and cap screw heads shall be hexagonal, unless otherwise specified. 1919.

(s) Bolts and cap screws, except for locking cams, shall be provided with spring lock washers where practicable. 1919.

(t) Taper dowel pin shall be No. 8 standard Morse taper two (2) inches in length. 1919.

(u) Straight dowel pins shall be one-fourth (¼) inch diameter. 1919.

(v) When necessary to hold parts in fixed relation to each other, dowel pins or body bound bolts shall be used. 1919.

(w) Moving parts of machine shall work freely, without lost motion. 1919.

(x) Machine shall be painted in accordance with R. S. A. specification for shop painting. 1919.

(y) All parts of machines shipped knocked-down shall be marked with steel figures on a finished surface and given the numbers which they take in the assembled machine. 1919.

(z) Locking bracket, cross locking, longitudinal locking and swing dogs shall be marked to read from back of machine. Longitudinal bars shall have their lever numbers marked directly over their dogs. Swing dogs shall be marked with lever number at trunnion end and space number at nose end 1919.

3. Machine legs.

(a) Legs for vertical locknut machine shall be two (2) feet seven and one-fourth (7¼) inches in height and base of leg shall be provided with four (4) holes for three-fourths (¾) inch bolts. 1919.

3. *Machine legs.*—Continued.

(b) Legs for horizontal leadout machines shall be three (3) feet five (5) inches in height and base of leg shall be provided with four (4) holes for three-fourths (¾) inch bolts. 1919.

4. *Bottom girders.*

(a) Bottom girders shall be fastened to legs with two (2) three-fourths (¾) inch thin square-head body-bound bolts. 1919.

(b) Caps shall be fastened to bottom girders with two (2) one-half (½) inch square-head machine bolts. 1919.

5. *Top plates.*

(a) Top plates shall be fastened to machine legs with six (6) one-half (½) inch T-head bolts; one (1) one-half (½) inch cap screw and four (4) taper dowel pins. 1919.

(b) End strips shall be fastened to top plates with two (2) one-half (½) inch T-head bolts. 1919.

6. *Levers.*

(a) Levers shall be five (5) feet, ten and one-eighth (10⅛) inches from center of fulcrum to end of handle. 1911.

(b) Levers shall have equal and uniform throw and shall be in true alignment. 1919.

(c) Tail levers shall be drilled to provide eight and three-fourths (8¾) inch stroke, nine and three-fourths (9¾) inch stroke, ten and three-fourths (10¾) inch stroke and shall be interchangeable as front or back tail levers. 1919.

(d) Lever shoes for vertical leadout machine shall provide approximately equal stroke above and below horizontal and so arranged that connection can be made to front or back tail lever. 1919.

(e) Two-position levers shall be designed to latch in normal and reverse positions. 1919.

(f) Three-position levers shall be designed to latch in normal, intermediate and reverse positions. 1919.

(g) Levers and tail levers for vertical leadout machine shall fit snugly into lever shoe and be fastened thereto with two (2) three-fourths (¾) inch body-bound bolts and one (1) taper dowel pin. 1919.

(h) Levers for horizontal leadout machine shall be fastened to lever shoe with three (3) three-fourths (¾) inch body-bound bolts and one (1) taper dowel pin. 1919.

3. Machine legs.—Continued.

(b) Legs for horizontal leadout machines shall be three (3) feet five (5) inches in height and bar of leg shall be provided with four (4) holes for three-fourths (¾) inch bolts.

4. Bottom girders.

(a) Bottom girders shall be fastened to legs with two (2) three-fourths (¾) inch thin square-head body-bound bolts.

(b) Caps shall be fastened to bottom girders with two (2) one-half (½) inch square-head machine bolts.

5. Top plates.

(a) Top plates shall be fastened to machine legs with six (6) one-half (½) inch T-head bolts, one (1) one-half (½) inch cap screw and four (4) taper dowel pins.

(b) End strips shall be fastened to top plates with two (2) one-half (½) inch T-head bolts.

6. Levers.

(a) Levers shall be five (5) feet, ten and one-eighth (10⅛) inches from center of fulcrum to end of handle.

(b) Levers shall have equal and uniform throw and shall be in true alignment.

(c) Tail levers shall be drilled to provide eight and three-fourths (8¾) inch stroke, nine and three-fourths (9¾) inch stroke, ten and three-fourths (10¾) inch stroke and shall be interchangeable as front or back tail levers.

(d) Lever shoes for vertical leadout machine shall provide approximately equal stroke above and below horizontal and so arranged that connection can be made to front or back tail lever.

(e) Two-position levers shall be designed to latch in normal and reverse positions.

(f) Three-position levers shall be designed to latch in normal, intermediate and reverse positions.

(g) Levers and tail levers for vertical leadout machine shall fit snugly into lever shoe and be fastened thereto with two (2) three-fourths (¾) inch body-bound bolts and one (1) taper dowel pin.

(h) Levers for horizontal leadout machine shall be fastened to lever shoe with three (3) three-fourths (¾) inch body-bound bolts and one (1) taper dowel pin.

6. *Levers.*—Continued.

(i) Lever shoe pins shall be one (1) inch diameter. End pins shall be held in place by one (1) three-eighths (3/8) inch square head, cupped point set screw through girder cap. 1919.

(j) Latch shoes shall provide for four and one-half (4½) inch opening for latch springs and be provided with an adjustable bushing. Top lip shall extend one (1) inch from face to latch shoe. Latch shoe shall be fastened to levers with two (2) one-half (½) inch tap bolts and one (1) taper dowel pin, the hole for dowel pin to be located below the hole for the lower tap bolt. 1919.

(k) Quadrants shall be fastened to top plates with three (3) one-half (½) inch bolts. 1919.

(l) Rocker links shall be fastened to quadrants with one (1) one (1) inch diameter grooved pin, pin to be held in place in quadrant with one (1) three-eighths (3/8) inch by five-eighths (5/8) inch cone point headless set screw. 1919.

(m) Latch rods shall be five-eighths (5/8) by twenty-four and three-fourths (24¾) inches from end of block to end of thread, thread to be S. A. E. standard (eighteen (18) threads to the inch) two and one-fourth (2¼) inches long and equipped with hexagon check nuts. Trunnion for latch block shall be equipped with one (1) one and one-half (1½) inch diameter cut washer and one (1) three-sixteenths (3/16) inch cotter pin. 1919.

(n) Latch nuts shall be straight, three (3) inches long from center of hole to end of nut and shall be tapped two and one-fourth (2¼) inches deep with an S. A. E. standard (eighteen (18) threads to the inch) five-eighths (5/8) inch tap. 1919.

(o) Latch springs shall be eleven-sixteenths (11/16) inch inside diameter and shall be of sufficient strength and range of compression to operate the locking bars when the lever is at either end of the quadrant and the latch is free to drop, and so designed that the additional compression obtainable by the adjustment is necessary only in machines above forty-four (44) levers. 1919.

(p) Latch handles shall be twelve (12) inches from center of holes to end of handle and shall be connected to lever and latch rod with two (2) one-half (½) inch round cheese-head pins. 1919.

6. Levers.—Continued.

(i) Lever shoe pins shall be one (1) inch diameter. End pins shall be held in place by one (1) three-eighths (⅜) inch square head, cupped point set screw through girder cap. 1919.

(j) Latch shoes shall provide for four and one-half (4½) inch opening for latch springs and be provided with an adjustable bushing. Top lip shall extend one (1) inch from face to latch shoe. Latch shoe shall be fastened to levers with two (2) one-half (½) inch tap bolts and one (1) taper dowel pin, the hole for dowel pin to be located below the hole for the lower tap bolt. 1919.

(k) Quadrants shall be fastened to top plates with three (3) one-half (½) inch bolts. 1919.

(l) Rocker links shall be fastened to quadrants with one (1) one (1) inch diameter grooved pin, pin to be held in place in quadrant with one (1) three-eighths (⅜) inch by five-eighths (⅝) inch cone point headless set screw. 1919.

(m) Latch rods shall be five-eighths (⅝) by twenty-four and three-fourths (24¾) inches from end of block to end of thread, thread to be S. A. E. standard (eighteen (18) threads to the inch) two and one-fourth (2¼) inches long and equipped with hexagon check nuts. Trunnion for latch block shall be equipped with one (1) one and one-half (1½) inch diameter cut washer and one (1) three-sixteenths (3/16) inch cotter pin. 1919.

(n) Latch nuts shall be straight, three (3) inches long from center of hole to end of nut and shall be tapped two and one-fourth (2¼) inches deep with an S. A. E. standard (eighteen (18) threads to the inch) five-eighths (⅝) inch tap. 1919.

(o) Latch springs shall be eleven-sixteenths (11/16) inch inside diameter and shall be of sufficient strength and range of compression to operate the locking bars when the lever is at either end of the quadrant and the latch is free to drop, and so designed that the additional compression obtainable by the adjustment is necessary only in machines above forty-four (44) levers. 1919.

(p) Latch handles shall be twelve (12) inches from center of holes to end of handle and shall be connected to lever and latch rod with two (2) one-half (½) inch round cheese-head pins. 1919.

6. *Levers.*—Continued.

(q) Combined foot and number plates shall be fastened to levers with one (1) one-half (½) inch round cheese-head pin. 1919.

(r) Universal links shall be five and three-fourths (5¾) inches center to center and connected to rocker links with one (1) one (1) inch flat swivel pin and one (1) one-half (½) inch round cheese-head pin. 1919.

(s) Link blocks shall be one by one and one-half by one and one-eighth (1 x 1½ x 1⅛) inches with a sliding fit, to have lip five-sixteenths (5/16) inch thick and not less than five-sixteenths (5/16) inch high. 1919.

7. *Locking.*

(a) Machine shall be provided with mechanical locking of the preliminary type. 1911.

(b) Machine shall be fully equipped with cross locking brackets and bars, and locking shafts with cranks and drivers. For each spare lever and each spare lever space one longitudinal locking bar shall be furnished for the full length of the machine. 1919.

(c) Locking shall be distributed as uniformly as possible without crowding. 1919.

(d) Bearings for front, back and intermediate rails shall be fastened to machine legs with four (4) one-half (½) inch bolts and two (2) taper dowel pins. 1919.

(e) Bearings for machines having locking beds twenty-four (24) way or wider shall be provided with adjustable supports. 1919.

(f) Front and back rails shall be interchangeable and fastened to bearing with one-half (½) inch cap screws and two (2) straight dowel pins. 1919.

(g) Intermediate rails shall be wide enough to accommodate two (2) standard locking brackets. 1919.

(h) Front, back and intermediate rails shall be provided with one-way caps, and caps shall be fastened to rails with two (2) three-eighths (⅜) inch cap screws. 1919.

(i) End blocks shall be fastened to rails with one (1) three-eighths (⅜) inch cap screw. 1919.

(j) Ends of locking shaft shall be square and have like dimensions. 1914.

(k) Drivers for end of locking shafts to be open approximately one-eighth (⅛) inch on back end to allow for tight clamping, to be fastened with one (1) one-half (½) inch body-bound bolt through shaft and connected to universal link with one (1) one-half (½) inch round cheese-head pin. 1919.

6. Levers.—Continued.

(q) Combined foot and number plates shall be fastened to levers with one (1) one-half (½) inch round cheese-head pin.

(r) Vertical links shall be five and three-fourths (5¾) inches center to center and connected to rocker links with one (1) and (1) inch flat swivel pin and one (1) one-half (1½) inch round cheese-head pin.

(s) Lock blocks shall be one by one and one-half by one and one-eighth (1 x 1½ x 1⅛) inches with a sliding fit, to have lip five-sixteenths (5/16) inch thick and not less than five-sixteenths (5/16) inch high.

7. Locking.

(a) Machine shall be provided with mechanical locking of the preliminary type.

(b) Machine shall be fully equipped with cross locking bracketts and bars, and locking shafts with cranks and drivers. For each spare lever and each spare lever space one longitudinal locking bar shall be furnished for the full length of the machine.

(c) Locking shall be distributed as uniformly as possible without crowding.

(d) Bearings for front, back and intermediate rails shall be fastened to machine legs with four (4) one-half (½) inch bolts and two (2) taper dowel pins.

(e) Bearings for machines having locking beds twenty-four (24) wide or wider shall be provided with adjustable supports.

(f) Front and back rails shall be interchangeable and fastened to bearing with one-half (½) inch cap screws and two (2) straight dowel pins.

(g) Intermediate rails shall be wide enough to receive modete two (2) standard locking bracketts.

(h) Front, back and intermediate rails shall be provided with one-way caps, and caps shall be fastened to rails with two (2) three-eighths (⅜) inch cap screws.

(i) Rod blocks shall be fastened to rails with one (1) three-eighths (⅜) inch cap screw.

(j) Ends of locking rods shall be square and have like dimensions.

(k) Drivers for end of locking shaft to be open approximately one-eighth (⅛) inch on back end to allow for light clamping, to be fastened with one (1) one-half (½) inch long round bolt through shaft and connected to universal link with one (1) one-half (½) inch round cheese-head pin.

7. *Locking.*—Continued.

(l) Drivers for longitudinal locking bars shall be of the clamp type with filler blocks and fastened to locking shafts with one (1) five-eighths (5/8) inch finished bolt and nut through block and end driver. 1919.

(m) Four, eight and twelve-way locking brackets only shall be used. Four-way brackets shall not be used in combination with eight and twelve-way brackets. 1919.

(n) Locking brackets shall be machined out for longitudinal bars to a depth of one and thirty-seven sixty-fourths (1 37/64) inch below finished top of bracket and shall be one and one-sixteenth (1 1/16) inch wide and for cross locking bars to a depth of twenty-five thirty-seconds (25/32) inch by forty-nine sixty-fourths (49/64) inch wide. Two (2) thirteen thirty-seconds (13/32) inch holes and one (1) hole for one (1) straight dowel pin shall be drilled with jig through each end of bracket and brackets shall be fastened to rails with four (4) three-eighths (3/8) inch cap screws and two (2) straight dowel pins. 1919.

(o) Longitudinal locking bars shall have one and three-fourths (1¾) inch stroke and shall be provided with stops for normal and reverse positions of the bar. The stop shall be of one-half by one-half (½ x ½) inch cold drawn steel and shall be located on the under side of longitudinal locking bar. 1919.

(p) Splices in longitudinal locking bars shall be made by means of two (2) channel clamps fastened with two (2) one-fourth (¼) inch bolts having nuts and cotters. Bars in smaller than forty (40) lever machine frame shall not be spliced. 1919.

(q) Trunnions for swing dogs shall be reversible with one-fourth (¼) inch diameter by one-eighth (⅛) inch high round dowel and shall be provided with washers and cotters. 1919.

(r) Swing dogs shall be reversible three-eighths (3/8) inch high by one-half (½) inch wide. 1919.

(s) Straight locking dogs shall be drilled so that a normal drive dog may be made a reverse dog by turning it end for end, a reverse dog made a normal dog in the same manner, and a double end dog made to take the place of either a normal or reverse dog. Holes for rivet heads shall be counter bored to eleven thirty-seconds (11/32) inch diameter and to a depth of three thirty-seconds (3/32) inch on both sides of the dog. 1919.

7. Locking.—Continued.

(l) Drivers for longitudinal locking bars shall be of the clamp type with filler blocks and fastened to locking bars with one (1) five-eighths (5/8) inch finished bolt and nut through block and driver.

(m) Four, eight and twelve-way locking brackets only shall be used. Four-way brackets shall not be used to combination with eight and twelve-way brackets.

(n) Locking brackets shall be machined out for longitudinal bars to a depth of one and thirty-seven sixty-fourths (1 37/64) inch below finished top of bracket and shall be one and one-sixteenth (1 1/16) inch wide and for cross locking bars to a depth of twenty-five thirty-seconds (25/32) inch by forty-nine sixty-fourths (49/64) inch wide. Two (2) thirteen thirty-seconds (13/32) inch holes and one (1) hole for one (1) straight dowel pin shall be drilled with jig through each end of bracket and brackets shall be fastened to rails with four (4) three-eighths (3/8) inch cap screws and two (2) straight dowel pins.

(o) Longitudinal locking bars shall have one and three-fourths (1¾) inch strokes and shall be provided with stops for normal and reverse positions of the bar. The stop shall be of one-half by one-half (½ x ½) inch cold drawn steel and shall be located on the under side of longitudinal locking bar.

(p) Splices in longitudinal locking bars shall be made by means of two (2) channel clamps fastened with two (2) one-fourth (¼) inch bolts having nuts and cotters. Bars in smaller than forty (40) lever machine frame shall not be spliced.

(q) Trunnions for swing dogs shall be reversible with one-fourth (¼) inch diameter by one-eighth (⅛) inch high round dowel and shall be provided with washers and cotters.

(r) Swing dogs shall be reversible three-eighths (⅜) inch high by one-half (½) inch wide.

(s) Straight locking dogs shall be drilled so that a normal drive dog may be made a reverse dog by turning it end for end, a reverse dog made a normal dog in the same manner, and a double end dog made to take the place of either a normal or reverse dog. Holes for rivet heads shall be countersunk to eleven thirty-seconds (11/32) inch diameter and to a depth of three thirty-seconds (3/32) inch on both sides of the dog.

7. *Locking.*—Continued.

(t) Locking drivers, dogs and stops shall be fastened to the longitudinal bars with two (2) one-fourth (¼) inch fillister head rivets and one (1) straight dowel pin. Swing dog trunnions shall be fastened to the longitudinal bars with two (2) one-fourth (¼) inch fillister head rivets. 1919.

(u) Latch blocks in locked combinations shall not have a lift of more than three-sixteenths (3/16) inch. 1919.

8. *Material and workmanship.*

(a) Material and workmanship shall be first-class in every respect. (S. S. 5-a.) 1911.

9. *Inspection.*

(a) Purchaser may inspect the material at all stages of manufacture. (S. S. 6-a.) 1919.

(b) Purchaser may inspect the completed product to determine that the requirements of this specification have been met. (S. S. 6-b.) 1919.

(c) If the material has not been accepted at point of production, and if, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected, and the Contractor, upon request, shall advise the Purchaser what disposition is to be made of the defective material. The Contractor shall pay all freight charges. (S. S. 6-c.) 1919.

(d) If Purchaser is to make inspection at point of production, it shall be so stated. (S. S. 6-d.) 1917.

10. *Tests.*

(a) Tests may be made at point of production, or on samples submitted, and may also be made at destination. (S. S. 7-a.) 1919.

(b) Contractor shall give the Purchaser sufficient notice of time when material will be ready for testing. (S. S. 7-b.) 1919.

(c) Contractor shall provide at point of production, apparatus and labor for making the required tests under supervision of the Purchaser. (S. S. 7-c.) 1919.

11. *Packing.*

(a) Material shall be so prepared as to permit convenient handling and to protect against loss or damage during shipment. (S. S. 8-a.) 1919.

12. *Marking.*

(a) Purchaser's order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of package. (S. S. 9-a.) 1919.

7. Locking.—Continued.

(c) Locking drivers, dogs and stops shall be fastened to the longitudinal bars with two (2) one-fourth (¼) inch flister head rivets and one (1) straight dowel pin. Swing dog trunnions shall be fastened to the longitudinal bars with two (2) one-fourth (¼) inch flister head rivets.

(d) Latch blocks in locked combinations shall not have a lift of more than three-sixteenths (3/16) inch.

8. Material and workmanship.

(a) Material and workmanship shall be first-class in every respect. (S. S. 5-a.)

9. Inspection.

(a) Purchaser may inspect the material at all stages of manufacture. (S. S. 6-a.)

(b) Purchaser may inspect the completed product to determine that the requirements of this specification have been met. (S. S. 6-b.)

(c) If the material has not been accepted at point of production, and it, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected, and the Contractor, upon request, shall advise the Purchaser what disposition is to be made of the defective material. The Contractor shall pay all freight charges. (S. S. 6-c.)

(d) If Purchaser is to make inspection at point of production, it shall be so stated. (S. S. 6-d.)

10. Tests.

(a) Tests may be made at point of production or on samples submitted, and may also be made at destination.

(S. S. 7-a.)

(b) Contractor shall give the Purchaser reasonable notice of time when material will be ready for testing.

(S. S. 7-b.)

(c) Contractor shall provide at point of production, apparatus and labor for making the required tests under supervision of the Purchaser. (S. S. 7-c.)

11. Packing.

(a) Material shall be so prepared as to secure conveniences handling and to protect against loss or damage during shipment. (S. S. 8-a.)

12. Marking.

(a) Each car order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of package.

(S. S. 9-a.)

12. *Marking.*—Continued.

(b) Detail list of loose pieces, containers and their contents, shall be furnished for each shipment. Where car-load shipments are made, routing and car identification shall be shown. (S. S. 9-b.) 1919.

(c) Where car-load shipments are made, name and address of Consignee may be omitted. (S. S. 9-c.) 1919.

13. *Warranty.*

(a) Contractor shall warrant the material covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to making, at point of production, any part or parts to replace those which shall be found defective within one (1) year after shipment to the Purchaser. This warranty shall not apply to any apparatus which shall have been repaired or altered in any way by anyone other than the Manufacturer thereof so as to, in the Contractor's judgment, affect its proper functioning or reliability nor which has been subject to misuse, negligence or accident. (S. S. 10-a.) 1919.

14. *Requisites for mechanical interlocking machine, A. R. A. specification.*

(a) Machine is for ..... R. R. to be located at ..... on inquiry ..... order ..... requisition ..... dated ..... 1919.

(b) Machine shall be in accordance with A. R. A. specification for ..... machine. 1919.

(c) Machine shall be arranged for { vertical / horizontal } lead-out. 1919.

(d) Machine shall have ..... working levers, ... spare levers, ... spare spaces, total ..... 1919.

(e) ..... two-position levers. 1919.

(f) ..... three-position levers. 1919.

(g) .....-way locking brackets shall be furnished. 1919.

(h) .....-way locking bed shall be furnished. 1919.

(i) Levers Nos. ..... shall be equipped with counterweights of ..... pounds to assist in moving them to the normal position. 1919.

(j) Levers Nos. ..... shall be equipped with counterweight of ..... pounds to assist in moving them to the reverse position. 1919.

12. Marking.—Continued.

(b) Detail list of loose pieces, containers and their contents, shall be furnished for each shipment. Where car-load shipments are made, routing and car identification shall be shown. (S. 8, p-b.) 1919.

(c) Where car-load shipments are made, name and address of Consignee may be omitted. (S. 8, p-c.) 1919.

13. Warranty.

(a) Contractor shall warrant the material covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to making at point of production, any part or parts to replace those which shall be found defective within one (1) year after shipment to the Purchaser. This warranty shall not apply to any apparatus which shall have been repaired or altered in any way by anyone other than the Manufacturer thereof or as to, in the Contractor's judgment, affect its proper functioning or reliability nor which has been subject to misuse, negligence or accident (S. 8, 13-a.) 1919.

14. Requisites for mechanical interlocking machine. (S. 8, A, 1919-edition.

(a) Machine to [illegible] K. R. to be located at [illegible] on highway [illegible] center [illegible] requisition [illegible] dated [illegible] 1919

(b) Machine shall be in accordance with A. R. A. specification for [illegible] machine [illegible] 1919

(c) Machine shall be arranged for [illegible] horizontal [illegible] vertical [illegible] levers out. 1919

(d) Machine shall have [illegible] working levers [illegible] spare levers [illegible] spare spaces [illegible] total [illegible] 1919

(e) [illegible] two-position levers. 1919.

(f) [illegible] three-position levers 1919.

(g) [illegible]-way locking brackets shall be furnished. 1919

(h) [illegible]-way locking bed shall be furnished. 1919

(i) Levers Nos. [illegible] shall be equipped with counterweights or [illegible] pounds to assist in moving them to the normal position. 1919.

(j) Levers Nos. [illegible] shall be equipped with counterweight of [illegible] pounds to assist in moving them to the reverse position 1919.

14. *Requisites for mechanical interlocking machine, A. R. A. specification.*—Continued.

(k) Levers shall be numbered and arranged in accordance with track and signal plan* number ....., dated ..... 1919.

(x) Remarks .... 1916.

(y) Signed ..... 1916.

(z) Date ..... 1916.

*Track and signal plan should have all main, side and auxiliary tracks properly designated, direction of traffic and routing of signals indicated. 1919.

14. Requirements for mechanical interlocking machines, A. R. A. specification.—Continued.

(b) Levers shall be numbered and arranged in accordance with track and signal plan* number . . . . . dated 1919

(x) Remarks 1920

(y) Signed . . . . . 1921.

(z) Date . . . . . 1922.

*Track and signal plan should have all main, side and auxiliary tracks properly designated, direction of traffic and routing of signals indicated.

SPECIFICATION FOR POWER INTERLOCKING MACHINE.

1919.

(Official Approval May, 1920.)

1. *Requisite sheet.*

(a) Requisite sheet, section 23, attached to this specification, shall form a part thereof. (S. S. 4-a.) 1919.

(b) Where blanks have not been filled, or where an option is permitted and no preference stated, the Contractor's recommended practice shall be followed. (S. S. 4-b.) 1919.

2. *Tender.*

(a) The tender shall be for apparatus meeting the requirements of this specification. If the Contractor wishes to vary from the specification, a tender may be submitted covering the apparatus he desires to furnish. This tender shall be accompanied by full information showing wherein the requirements of the specification are varied from. (S. S. 3-a.) 1919.

3. *Drawings.*

(a) Purchaser's drawings accompanying this specification and forming an essential part thereof, are as follows:

.....

.....

(S. S. 2-a.) 1919.

(b) Track and signal plan, locking and dog sheet and combination wiring plan shall be approved by the Purchaser. 1919.

4. *General.*

(a) Bolts and screws shall have U. S. standard thread where practicable. 1919.

(b) Nuts, bolts and cap screw heads shall be hexagonal, unless otherwise specified. 1919.

(c) Bolts and cap screws shall be provided with spring lock washers where practicable. 1919.

(d) Taper dowel pins shall be standard taper one-fourth (¼) inch per foot. 1919.

(e) When necessary to hold parts in fixed relation to each other, dowel pins or body-bound bolts shall be used. 1919.

5. *Design.*

(a) The machine frame and locking bed shall be so designed that additional sections may be added on either end. 1919.

(b) Like parts of the same manufacturer's machine shall be interchangeable. 1919.

American Railroad Association.
Signal Division.

SPECIFICATION FOR POWER INTERLOCKING MACHINE.

1919.

(Official Approval May, 1920.)

1. Requisite sheet.

(a) Requisite sheet, section 03, attached to this specification, shall form a part thereof. (S. S. 4-a.) 1919.

(b) Where blanks have not been filled, or where an option is permitted and no preference stated, the Contractor's recommended practice shall be followed (S. S. 4-b.) 1919.

2. Tender.

(a) The tender shall be for apparatus meeting the requirements of this specification. If the Contractor wishes to vary from the specification a tender may be submitted covering the apparatus he desires to furnish. This tender shall be accompanied by full information showing wherein the requirements of the specification are varied from. (S. S. 5-a.) 1919.

3. Drawings.

(a) Purchaser's drawings accompanying this specification and forming an essential part thereof, are as follows:

.....

.....

(S. S. 6-a.) 1919.

(b) Track and signal plan, locking and dog sheet and combination wiring plan shall be approved by the Purchaser. 1919.

4. General.

(a) Bolts and pockets shall have U. S. standard thread where practicable. 1919.

(b) Nuts, bolts and cap screw heads shall be hexagonal, unless otherwise specified. 1919.

(c) Rolls and cap screws shall be provided with spring lock washers where practicable 1919.

(d) Taper dowel pins shall be standard taper one-fourth (¼) inch per foot. 1919.

(e) When necessary to bind parts in fixed relation to each other, dowel pins or body-bound bolts shall be used 1919.

5. Design.

(a) The machine frame and locking bed shall be so designed that additional sections may be added at either end 1919.

(b) Like parts of the same manufacturer's machine shall be interchangeable. 1919

6. *Locking.*

(a) Machine shall be provided with mechanical locking of the preliminary type. 1911.

(b) For each spare lever and each spare space, provisions shall be made in the locking bed to accommodate either:

1. One (1) locking shaft with one (1) cross locking bar and one (1) longitudinal locking bar for the full length of the machine. 1919.

2. One (1) tappet with one (1) longitudinal locking bar for the full length of the machine. 1919.

(c) The machine shall be equipped complete with locking guides or brackets. 1919.

(d) Locking shall be distributed as uniformly as possible without crowding and so arranged as to be easily accessible. 1919.

7. *Levers.*

(a) Levers shall be numbered from left to right, in accordance with requisite sheet. 1919.

(b) Levers shall be arranged so they can be removed without interfering with the operation of other levers. 1919.

(c) Spare levers shall be furnished in place complete with magnets, standard circuit controllers, locking shaft and driver, or tappet, and connections and tappet complete for the operation and control of their respective units. 1919.

(d) Two-position levers shall be designed to latch in the reverse position and in addition all levers, except those of the horizontal slide type, to latch in the normal position. 1919.

(e) Three-position levers shall be designed to latch in the normal, intermediate and reverse positions. 1919.

(f) Levers shall be designed to permit the application of electric locks or mechanically operated time releases, independent of indication locks. 1919.

8. *Case.*

(a) Machine shall be enclosed in a case, which shall have separate removable doors or panels of convenient size to give access to all parts of the machine, and shall be provided with locks as specified on requisite sheet. 1919.

9. *Painting.*

(a) Painting of the machine shall be in accordance with R. S. A. specification for shop painting. 1919.

10. *Dielectric requirements.*

(a) Unless otherwise specified, electric apparatus assembled shall withstand an insulation test, at place of manufacture, of three thousand (3000) volts a.c. between all parts of electric circuits and other metallic parts insulated therefrom. (G. E. R. 30-a.) 1919.

(b) A surface leakage distance of not less than one-fourth (¼) inch shall be provided between any exposed metallic part of the apparatus carrying current and any other metallic part thereof. (G. E. R. 30-b.) 1919.

(c) Separate windings, which are insulated from each other, shall withstand for one (1) minute an insulation test of three thousand (3000) volts a.c. between their terminals. (G. E. R. 30-c.) 1919.

(d) A potential of twice the normal operating requirements at a suitable frequency shall be impressed across the windings without any excessive flow of current indicating a short circuit. (G. E. R. 30-d.) 1919.

11. *Insulation.*

(a) Coils and windings shall be of cotton or silk-covered wire, impregnated; of enameled wire, or as shown on requisite sheet. Enameling or impregnation, shall be in accordance with R. S. A. specifications. (G. E. R. 32-a.) 1919.

(b) Material used for insulation shall be such as will not be injuriously affected by atmospheric conditions. (G. E. R. 32-b.) 1917.

12. *Circuit controllers.*

(a) Machine shall be equipped with Manufacturer's standard circuit controllers necessary for the control of the circuits shown on drawings listed on requisite sheet. 1919.

13. *Indication.*

(a) Levers for the control of switches, derails, movable frogs, crossing bars, drawbridge locks and bolt locks shall be equipped with devices to insure the locking of the units in a position corresponding to the position of the levers before the release of the mechanical locking can be effected. 1919.

(b) Levers for the control of signals shall be equipped with devices to prevent the release of the mechanical locking until the signals directly or indirectly controlled have assumed their normal position. 1919.

(c) Switch levers shall be free to move between their indicating positions. 1919.

10. Dielectric requirements.

(a) Unless otherwise specified, electric apparatus assembled shall withstand an insulation test, at place of manufacture, of three thousand (3000) volts a.c. between all parts of electric circuits and other metallic parts insulated therefrom. (C. E. R. 30-a.) 1919.

(b) A surface leakage distance of not less than one-fourth (¼) inch shall be provided between any exposed metallic part of the apparatus carrying current and any other metallic part thereof. (C. E. R. 30-b.) 1919.

(c) Separate windings, which are insulated from each other, shall withstand for one (1) minute an insulation test of three thousand (3000) volts a.c. between them terminals. (C. E. R. 30-c.) 1919.

(d) A potential of twice the normal operating requirements at a suitable frequency shall be impressed across the windings without any excessive flow of current indicating a short circuit. (C. E. R. 30-d.) 1919.

11. Insulation.

(a) Coils and windings shall be of cotton or silk-covered wire, impregnated of enameled wire, or as shown on requisite sheet. Enameling or impregnation shall be in accordance with R. S. A. specifications. (C. E. R. 32-a.) 1919

(b) Material used for insulation shall be such as will not be injuriously affected by atmospheric conditions. (C. E. R. 32-b.) 1919.

12. Circuit controllers.

(a) Machine shall be equipped with Manufacturer's standard circuit controllers necessary for the control of the circuits shown on drawings listed on requisite sheet. 1919.

13. Indication

(a) Levers for the control of switches, derails, movable frogs, crossing bars, drawbridge locks and bolt locks shall be equipped with devices to insure the locking of the units in a position corresponding to the position of the levers before the release of the mechanical locking can be effected. 1919

(b) Levers for the control of signals shall be equipped with devices to prevent the release of the mechanical locking until the signals directly or indirectly controlled have assumed their normal position. 1919

(c) Switch levers shall be free to move between their indicating positions. 1919

14. *Terminal board.*

(a) Machine shall be provided with a terminal board, constructed from insulating material, and provided with terminals as specified on requisite sheet. 1919.

15. *Lever light indicators.*

(a) Lever light indicators shall be of the type specified on requisite sheet. 1919.

(b) Lever light indicators, when required, shall be located in front of the machine immediately above or below the levers. 1919.

(c) Electric lamps for lever light indicators shall be as specified on requisite sheet. 1919.

16. *Contacts.*

(a) Contact springs shall be made of highly non-corrosive material of sufficient mechanical strength and current carrying capacity to satisfactorily operate in connection with the circuits used. 1919.

17. *Material and workmanship.*

(a) Material and workmanship shall be first-class in every respect. (S. S. 5-a.) 1911.

18. *Inspection.*

(a) Purchaser may inspect the material at all stages of manufacture. (S. S. 6-a.) 1919.

(b) Purchaser may inspect the completed product to determine that the requirements of this specification have been met. (S. S. 6-b.) 1919.

(c) If material has not been accepted at point of production, and if, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected, and the Contractor, upon request, shall advise the Purchaser what disposition is to be made of the defective material. The Contractor shall pay all freight charges. (S. S. 6-c.) 1919.

(d) If Purchaser is to make inspection at point of production, it shall be so stated. (S. S. 6-d.) 1919.

19. *Tests.*

(a) Tests may be made at point of production or on samples submitted, and may also be made at destination. (S. S. 7-a.) 1919.

(b) Contractor shall give the Purchaser sufficient notice of time when material will be ready for testing. (S. S. 7-b.) 1919.

(c) Contractor shall provide, at point of production, apparatus and labor for making the required tests under supervision of the Purchaser. (S. S. 7-c.) 1919.

14. Terminal board.

(a) Machine shall be provided with a terminal board, constructed from insulating material, and provided with terminals as specified on requisite sheet. 1919.

15. Lever light indicators.

(a) Lever light indicators shall be of the type specified on requisite sheet. 1919.

(b) Lever light indicators, when required, shall be located in front of the machine immediately above or below the levers. 1919.

(c) Electric lamps for lever light indicators shall be as specified on requisite sheet. 1919.

16. Contacts.

(a) Contact springs shall be made of highly non-corrosive material of sufficient mechanical strength and current carrying capacity to satisfactorily operate in connection with the circuits used 1919.

17. Material and workmanship.

(a) Material and workmanship shall be first-class in every respect. (S. S. 3-a.) 1911.

18. Inspection.

(a) Purchaser may inspect the material at all stages of manufacture. (S. S. 6-a.) 1919.

(b) Purchaser may inspect the completed product to determine that the requirements of this specification have been met. (S. S. 6-b.) 1919.

(c) If material has not been accepted at point of production, and if, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected, and the Contractor upon request, shall advise the Purchaser what disposition is to be made of the defective material. The Contractor shall pay all freight charges. (S. S. 3-c.) 1919.

(d) If Purchaser is to make inspection at point of production, it shall be so stated. (S. S. 6-d.) 1919.

19. Tests.

(a) Tests may be made at point of production or on samples submitted, and may also be made at destination.

(S. S. 7-a.) 1919.

(b) Contractor shall give the Purchaser sufficient notice of time when material will be ready for test. (S. S. 7-b.) 1919.

(c) Contractor shall provide, at point of production, apparatus and labor for making the required tests under supervision of the Purchaser (S. S. 7-c.) 1919.

20. *Packing.*

(a) Material shall be so prepared as to permit convenient handling and to protect against loss or damage during shipment. (S. S. 8-a.) 1919.

21. *Marking.*

(a) Purchaser's order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of package. (S. S. 9-a.) 1919.

(b) Detail list of loose pieces, containers and their contents, shall be furnished for each shipment. Where car-load shipments are made, routing and car identification shall be shown. (S. S. 9-b.) 1919.

(c) Where car-load shipments are made, name and address of Consignee may be omitted. (S. S. 9-c.) 1919.

22. *Warranty.*

(a) Contractor shall warrant the material covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to making, at point of production, any part or parts to replace those which shall be found defective within one (1) year after shipment to the Purchaser. This warranty shall not apply to any apparatus which shall have been repaired or altered in any way by anyone other than the Manufacturer thereof so as to, in the Contractor's judgment, affect its proper functioning or reliability, nor which has been subject to misuse, negligence or accident. (S. S. 10-a.) 1919.

23. *Requisites for power interlocking machine, A.R.A. specification.*

(a) Machine is for ..... R. R.
{ Location ..... / Inquiry No. ..... / Order No. ..... / Requisition ..... / dated ..... } 1919.

(b) Machine shall be in accordance with R. S. A. specification. 1919.

(c) Purchaser will fill in such items as he desires to specify. Contractor will fill in all other blanks, so that the requisite sheet will be complete when finally submitted with Contractor's quotations. 1919.

(d) Levers shall be numbered and arranged in accordance with track and signal plan ....., dated ..... 1919.

(e) Machine shall be as shown on Contractor's general drawing ....., dated ....., or catalogue reference. ..... 1919.

20. Packing.

(a) Material shall be so packed as to permit convenient handling and to protect against loss or damage during shipment. (S. S. S-a.) 1919.

21. Marking.

(a) Purchaser's order, registration and package number, name of Consignee, and name and address of Consignor, shall be plainly marked on outside of package (S. S. S-a.) 1919.

(b) Detail list of loose pieces contained and other contents, shall be included for each shipment. Where car-load shipments are made, routing and car identification shall be shown. (S. S. S-b.) 1919.

(c) Where car-load shipments are made, name and address of Consignee may be omitted. (S. S. S-c.) 1919.

22. Warranty.

(a) Contractor shall warrant the material covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to making at point of production, any part or parts to replace those which shall be found defective within one (1) year after shipment to the Purchaser. This warranty shall not apply to any apparatus which shall have been repaired or altered in any way by anyone other than the Manufacturer thereof so as to, in the Contractor's judgment, affect its proper functioning or reliability, nor which has been subject to misuse, negligence or accident (S. S. 10-a.) 1919.

23. Requirements for power mortising machine. A. S. A. specification.

(a) Machine is for ..... R. R.

Location	
Inquiry No.	
Order No.	
Requisition	
dated	

(b) Machine shall be in accordance with R. E. A. specification 1919

(c) Purchaser will fill in such items as he desires to specify. Contractor will fill in all other blanks, to that the requisite buyer will be complete when finally submitted with Contractor's quotations ..... 1919.

(d) Leaves shall be numbered and arranged in accordance with track and signal plan ....., dated .....

.....

(e) Machine shall be as shown on Contractor's general drawing ..... dated ..... , or catalogue reference ..... 1919.

23. *Requisites for power interlocking machine.*—Continued.

(f) *Upon the completion of the work called for by this specification, the following Contractor's drawings shall become the property of the Purchaser:

1. Track and location plan ....
2. Locking sheet ....
3. Dog chart ....
4. Combination wiring ....
5. Manipulation chart ....
6. Track diagram ....
7. Cable and wiring plans ....

1919.

(g) Levers:

Lever frame:

Working levers, Signal .....
Switch .....
.....
.....

Spare levers, Signal .....
Switch .....
.....
.....

Spare spaces .....
Total .....

1919.

(h) Machine shall be designed for the control of circuits the maximum voltage of which will be .....

volts { direct ..... } current, and
{ ..... }
{ ..... cycles alternating }

where special requirements are to be met .....
amperes. 1919.

(i) Electric locks together with normally open circuit controllers in addition to the indication locks (magnets),

shall be provided for { section locking. }
{ approach locking. }
{ check locking. }
{ ..... locking. }

1919.

*Indicate by X in column whether tracing or print is to be furnished.

23. Requirements for power interlocking machines.—Continued

(f) *Upon the completion of the work called for by this specification, the following Contractor's drawings shall become the property of the Railroad:

1. Track and location plan
2. Locking sheet
3. Dog chart
4. Combination wiring
5. Manipulation chart
6. Track diagram
7. Cable and wiring plans

(g) Levers:

Lever frame:

Working levers, Signal
Switch

Spare levers, Signal
Switch

Spare spaces

Total

(h) Machine shall be designed for the control of electric the maximum voltage of which will be

volts { direct
cycles alternating } current, and

where special requirements are to be met
amperes.

(i) Electric locks together with normally open electric controllers in addition to the indication locks (separately)

shall be provided for { section locking,
approach locking,
detail locking,
locking.

*Indicate by X in column whether locking or spring is to be furnished

23. *Requisites for power interlocking machine.*—Continued.

(j) Electric lock magnets shall be arranged for normal operation at ..... volts { direct ..... / ..... / ..... cycles, alternating } current. 1919.

(k) Lever indicators shall be of the { electric light / ..... / ..... } type for normal operation at ..... volts { direct ..... / ..... / ..... alternating } current. 1919.

(l) Lever indicator lamps shall be { carbon / ..... / ..... } filament for normal operation at ..... volts { direct ..... / ..... / ..... } current, with ..... base and ..... bulb. 1919.

(m) Levers controlling switches and derails { shall / shall not } be provided with lever indicators. 1919.

(n) Levers controlling signals { shall / shall not } be provided with lever indicators. 1919.

(o) Auxiliary circuit controllers of the { spring ..... / ..... / mechanical stick } type shall be provided for the following levers ..... and shall have ..... contacts. 1919.

(p) Automatic time release providing ..... seconds retardation in lever movement shall be provided for the following levers ..... 1919.

(q) Insulation of coils and windings, if not enameled wire, or fabric covered wire impregnated, shall be as follows .....
.....
1919.

43 Requisites for power interlocking machines.—Continued.

23. *Requisites for power interlocking machine.*—Continued.

(r) Case:

Case shall be of { steel, enamel / wood ..... / ..... } finish and equipped with { Purchaser's standard cabinet ..... / ..... } locks. 1919.

(s) Terminal board shall be constructed of ....material and shall be provided with terminals { R. S. A. 1070 / ..... } for making connections to the machine. 1919.

(t) Inspection and tests:

1. Inspections and tests { shall / shall not } be made at point of production under supervision of Purchaser. 1919.

2. Purchaser requires ..... days' notice before apparatus will be ready for inspection and tests. 1919.

3. Inspection or tests { shall / shall not } be made at destination by Purchaser. 1919.

4. Inspection or tests as made by Contractor { shall / shall not } be acceptable. 1919.

(x) Remarks .... 1916.

(y) Signed ..... 1916.

(z) Date ..... 1916.

2a. Remarks for power interlocking machine.—Continued.

(a) Case:

Case shall be of { steel casing / ... } finish and

equipped with { Pendulum / ... } levers

(b) Terminal board shall be constructed of .....
material and shall be provided with terminals

{ B. & A. wire / ... } for making connections to the machine

(c) Inspection and tests:

1. Inspection and tests { shall / shall not } be made at

point of production under supervision of Purchaser.

2. Purchaser requires ..... days' notice
before apparatus will be ready for inspection and
tests.

3. Inspection or tests { shall / shall not } be made at

destination by Purchaser.

4. Inspection or tests as made by Contractor

{ shall / shall not } be acceptable

(d) Remarks .....

.....

(e) Signed .....

(f) Date .....

SPECIFICATION FOR PETROLATUM FOR USE IN IMPEDANCE BONDS.

1919.

(Official Approval May, 1920.)

1. *Requisite sheet.*

(a) Requisite sheet, section 7, attached to this specification, shall form a part thereof. (S. S. 4-a.) 1919.

(b) Where blanks have not been filled, or where an option is permitted and no preference stated, the Contractor's recommended practice shall be followed. (S. S. 4-b.) 1919.

2. *Material.*

(a) Shall be a pure mineral oil, free from crystalline wax, acid, alkali, or other chemicals. 1919.

(b) It shall conform to the following physical characteristics:

1. The specific gravity shall be between twenty-seven (27) degrees Baume eight hundred ninety-one thousandths (.891) and thirty (30) degrees Baume eight hundred seventy-five thousandths (.875).

2. The flash shall be not less than two hundred forty-six (246) degrees C. (474° F.).

3. The viscosity at ninety-nine (99) degrees shall be between one hundred and five (105) sec. and one hundred and twenty (120) sec. taken in a Saybolt Standard Universal Viscosimeter.

4. The melting point shall be between forty-nine (49) degrees C. and fifty-seven (57) degrees C. taken by the Saybolt method.

5. The solidifying point shall be between forty-nine (49) degrees C. (120° F.) and fifty-seven (57) degrees C. (135° F.) 1919.

3. *Inspection.*

(b) Purchaser may inspect the completed product to determine that the requirements of this specification have been met. (S. S. 6-b.) 1919.

(c) If the material has not been accepted at point of production, and if, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected and the Contractor, upon request, shall advise the Purchaser what disposition is to be made of the defective material. The Contractor shall pay all freight charges. (S. S. 6-c.) 1919.

(d) If Purchaser is to make inspection at point of production, it shall be so stated. (S. S. 6-d.) 1917.

SPECIFICATION FOR PETROLATUM FOR USE IN IMPEDANCE BONDS

1919

(Official Approval, May, 1920)

1. Requisite sheet.

(a) Requisite sheet, section 7 attached to this specification, shall form a part thereof. (S. 8, 4-c)

(b) Where blanks have not been filled, or where an option is permitted and no preference stated the Contractor's recommendation thereon shall be followed.

(S. S 8-b, 1919.

2. Material

(a) Shall be a pure mineral oil free from crystallizing wax, acid, alkali, or other chemicals.

(b) It shall conform to the following physical requirements:

1. The electric strength shall be between twenty-seven (27) degrees Baume clear limited monstrosities (Abr) and thirty (30) degrees Baume eight hundred seventy-five thousandths (.875).

2. The test shall be not less than two hundred forty six (two) degrees C. (234° F.).

3. The viscosity at ninety-nine (99) degrees shall be between one hundred and five (105) no. and one hundred and twenty (120) sec. taken on a Engler standard Universal Viscosimeter.

4. The melting point shall be between forty-six (46) degrees C and fifty-two (52) degrees C taken by the Bayvolt method.

5. The solidifying point shall be between forty-nine (49) degrees C. (120° F.) and fifty-seven (57) degrees C. (135° F.)

3. Inspection.

(b) Purchaser may inspect the completed product to determine that the requirements of this specification have been met.

(S. S 8-b, 1919.

(c) If the material has not been accepted at point of production, and if, upon arrival at destination, it does not meet the requirements of this specification, it may, rejected and the Contractor, upon request, shall advise the Purchaser what disposition is to be made of the defective material. The Contractor shall pay all freight charges

(S. S 8-c, 1919.

(d) If Purchaser is to make inspection at point of production, it shall be so made.

(S. S 8-d, 1919.

4. *Tests.*

(a) Tests may be made at point of production, or on samples submitted, and may also be made at destination. (S. S. 7-a.) 1919.

(b) Contractor shall give the Purchaser sufficient notice of time when material will be ready for testing. (S. S. 7-b.) 1919.

(c) Contactor shall provide, at point of production, apparatus and labor for making the required tests under supervision of the Purchaser. (S. S. 7-c.) 1919.

5. *Marking.*

(a) Purchaser's order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of package. (S. S. 9-a.) 1919.

(b) Detail list of loose pieces, containers and their contents, shall be furnished for each shipment. Where car-load shipments are made, routing and car identification shall be shown. (S. S. 9-b.) 1919.

(c) Where car-load shipments are made, name and address of Consignee may be omitted. (S. S. 9-c.) 1919.

6. *Packing.*

(a) Material shall be so prepared as to permit convenient handling and to protect against loss or damage during shipment. (S. S. 8-a.) 1919.

7. *Requisites for petrolatum for use in impedance bond, A. R. A. specification.*

(a) Purchaser to fill in such items as he desires to specify. Contractor to fill in all other blanks, so that the requisite sheet will be complete when finally submitted with Contractor's quotation. 1919.

(b) Identification.

Petrolatum covered by this sheet is for .....
Railroad on Inquiry ..... Order .....
Requisition ..... and is to be used for .....
at ..... 1919.

(c) Quantity required ..... 1917.

(d) Shall be shipped in containers:

1. Steel drums ..... gallons capacity.
2. Wood barrels ..... gallons capacity.
3. ..... gallons capacity.

1919.

7. *Requisites for petrolatum for use in impedance bond, A. R. A. specification.*—Continued.

(e) Inspection and tests.

1. Shall inspection or tests be made at point of production under supervision of Purchaser? .... 1917.

2. ..... days notice required by Purchaser before apparatus will be ready for inspection or test. 1916.

3. Shall inspection or test be made at destination by Purchaser? ..... 1918.

4. Shall record of inspection and tests as furnished by Contractor be accepted? ..... 1919.

(x) Remarks ..... 1916.

(y) Signed ..... 1916.

(z) Date ..... 1916.

PHRASES AND WORDS.

1919.

(Official Approval May, 1929.)

(a) Use the phrases:

1. In accordance with. 1919.
2. Conform to. 1919.

(b) Use the words:

1. May, in optional cases, in specifications and requisites. 1919.
2. Must, in imperative cases, in rules and instructions. 1919.
3. Shall, in imperative cases, in specifications and requisites. 1919.
4. Should, in desirable cases, in specifications and requisites. 1919.
5. Will, where reference is made to the Purchaser's responsibility. 1919.

American Railroad Association.
Signal Division.

SPECIFICATION FOR ALTERNATING CURRENT RELAY.

1919.

(Official Approval May, 1920.)

1. *Requisite sheet.*

(a) Requisite sheet, section 18, attached to this specification, shall form a part thereof. (S. S. 4-a.) 1919.

(b) Where blanks have not been filled, or where an option is permitted and no preference stated, the Contractor's recommended practice shall be followed. (S. S. 4-b.) 1919.

2. *Tender.*

(a) The tender shall be for apparatus meeting the requirements of this specification. If the Contractor wishes to vary from the specification a tender may be submitted covering the apparatus he desires to furnish. This tender shall be accompanied by full information showing wherein the requirements of the specification are varied from. (S. S. 3-a.) 1919.

3. *Design.*

(a) The relay shall be of a design approved by the Purchaser. 1912.

(b) Moving parts, with the exception of the pneumatically operated portion of the electropneumatic relays, shall be enclosed in a weather-proof, dust-proof case, ventilated or non-ventilated, as specified on requisite sheet. 1919.

(c) The enclosure for the contact parts shall be so designed that the contacts may be readily seen, by inspection, from the outside. 1916.

(d) All metal parts liable to corrosion, except wearing and contact surfaces, shall be protected from corrosion. Material used for protection shall not soften or flake off between temperatures thirty-five (35) degrees C. below zero (—31° F.) and sixty-five (65) degrees C. above zero (149° F.). 1916.

4. *Binding posts.*

(a) Binding posts shall be of brass and so constructed that they cannot be turned in the base or frame to which they are fastened. The threaded part, nuts and washers shall be in accordance with R. S. A. 1070. 1919.

(b) Binding posts supporting the fixed parts of front and back contacts shall be fastened in their supports in such a manner as to preclude adjustment of any kind without first breaking the seal of the relay. 1912.

4. *Binding posts.*—Continued.

(c) Binding posts shall be arranged so that the wires connecting to them will be held in such a manner that shrinkage of the binding post support will not loosen the connections. 1912.

(d) Binding posts shall be so spaced that they will be separated by not less than three-eighths (3/8) inch air space. 1912.

5. *Flexible connections.*

(a) The flexible connections from binding posts to contact fingers shall carry ten (10) amperes continously without injury. If a larger current carrying capacity is required, the flexible connections shall carry continuously without injury the current specified on requisite sheet. 1919.

6. *Contacts.*

(a) Contacts in normal operation shall make a wiping contact and shall exert a pressure of not less than five-tenths (0.5) ounce. 1916.

(b) Resistance of cleaned contacts shall not exceed five-tenths (0.5) ohm.

(c) Contacts shall be so adjusted that in their open position there shall be at least thirty-one thousandths (0.031) inch space between the fixed post and the contacting point. 1916.

(d) All parts of the contact fingers (other than the contact point), including its flexible connections and the post to which the ribbon is attached, shall be separated by at least one-tenths (0.1) inch from any other metal or conducting part of the relay. 1919.

(e) Contact shall be of material as specified on requisite sheet. 1919.

(f) The contacts shall be designed to carry continuously and break the currents as specified on requisite sheet. 1919.

7. *Dielectric requirements.*

(a) Unless otherwise specified, electric apparatus assembled shall withstand for one (1) minute an insulation test, at place of manufacture, of three thousand (3000) volts a.c. between all parts of electric circuits and other metallic parts insulated therefrom. (G. E. R. 30-a. 1919.

(b) A surface leakage distance of not less than three-eighths (3/8) inch shall be provided between any exposed metallic part of the apparatus carrying current and any other metallic part thereof. (G. E. R. 30-b.) 1919.

(e) Separate windings which are insulated from each

30-e. *Dielectric requirements.*—Continued.

other and from other metal or conducting parts of the relay shall withstand a test of three thousand (3000) volts a.c. for one (1) minute. This voltage shall be applied between terminals of the separate windings and between terminals and other metal or conducting parts from which the terminals and windings are insulated. 1916.

(d) A potential of twice the normal operating requirements at a suitable frequency shall be impressed across the windings without any excessive flow of current indicating a short circuit. (G. E. R. 30-d.) 1918.

8. *Insulation.*

(a) Coils and windings shall be of cotton or silk covered wire, impregnated; of enameled wire, or as shown on requisite sheet. Enameling, or impregnation, shall be in accordance with R. S. A. specifications.
(G. E. R. 32-a.) 1919.

(b) Material used for insulation shall be such as will not be injuriously affected by atmospheric conditions.
(G. E. R. 32-b.) 1917.

9. *Clearance.*

(a) Under the most unfavorable conditions of play and relative position of parts in the assembled relay, all moving parts except bearings and contacts shall be separated by not less than the following guaranteed minimum clearances:

1. Radial .020 inch.
2. Longitudinal .017 inch.
3. The guaranteed minimum end play of the moving element shall be .010 inch. 1916.

10. *Operation.*

(a) The contacts closed with the relay energized shall open from the fully energized position by a gradual reduction in voltage at a per cent. as shown on requisite sheet (which shall, however, be not less than forty-five (45) per cent. of the voltage required to just close the contacts). In case of two-element relays this test shall be made by reducing the voltage on the controlled element only, the voltage on the local element being maintained at constant rated value. 1919.

(b) The voltage required to make contact shall not be less than fifty (50) per cent. of the voltage required to bring the contacts to their rated pressure. In case of two-element relays this test shall be made by varying the voltage on the controlled element only. 1916.

(c) The relay shall perform satisfactorily when the voltage on all elements is reduced to eighty-five (85) per cent. of their rated voltages. 1916.

30-e. Dielectric requirements.--Continued.

other and from other metal or conducting parts of the relay shall withstand a test of three thousand (3000) volts a.c. for one (1) minute. This voltage shall be applied between terminals of the separate windings and between terminals and other metal or conducting parts from which the terminals and windings are insulated.

(d) A potential of twice the normal operating requirements at a suitable frequency shall be impressed across the windings without any excessive flow of current indicating a short circuit. (G. E. R. 30-d.) 1918.

8. Insulation.

(a) Coils and windings shall be of cotton or silk covered wire, impregnated, of enameled wire, or as shown on requisite sheet. Enameling, or impregnation, shall be in accordance with R. S. A. specifications.

(G. E. R. 32-a.) 1919.

(b) Material used for insulation shall be such as will not be injuriously affected by atmospheric conditions.

9. Clearance. (G. E. R. 32-b.) 1919.

(a) Under the most unfavorable conditions of play and relative position of parts in the assembled relay, all moving parts except bearings and contacts shall be separated by not less than the following guaranteed minimum clearances:

1. Radial, one inch.
2. Longitudinal, one inch.
3. The guaranteed minimum end play of the moving element shall be one inch 1918

10. Operation.

(a) The contacts closed with the relay energized shall open from the fully energized position by a gradual reduction in voltage at a per cent. as shown on requisite sheet (which shall, however, be not less than forty-five (45) per cent. of the voltage required to just close the contacts). In case of two-element relays this test shall be made by reducing the voltage on the connected element only, the voltage on the local element being maintained at constant rated value. 1919.

(b) The voltage required to make contact shall not be less than fifty (50) per cent. of the voltage required to bring the contacts to their rated pressure. In case of two-element relays this test shall be made by varying the voltage on the connected element only. 1919.

(c) The relay shall perform satisfactorily when the voltage on all elements is reduced to eighty-five (85) per cent. of their rated voltage. 1918.

10. *Operation.*—Continued.

(d) For two-element track relays the above readings shall be made with ideal phase relations between the currents in the two windings. 1916.

(e) For two-element line relays the above readings shall be made with phase relations between the two windings which approximate conditions as specified on requisite sheet. 1916.

11. *Operating data.*

(a) Each relay shall bear a metal name plate on which is stated:

1. Rated volts and amperes at terminals of each element. 1919.
2. Frequency. 1919.

(b) The following additional data shall be stated on either metal name plate or a paster:

1. Manufacturer's name. 1919.
2. Type. 1919.
3. Serial number. 1919.
4. Type of external device. 1919.
5. Volts, including external device. 1919.

(c) Both metal name plate and paster shall be so located that they can be readily seen when the relay is in its operating position. 1916.

12. *Inspection.*

(a) Purchaser may inspect the material at all stages of manufacture. (S. S. 6-a.) 1919.

(b) Purchaser may inspect the completed product to determine that the requirements of this specification have been met. (S. S. 6-b.) 1919.

(c) If the material has not been accepted at point of production, and if, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected, and the Contractor, upon request, shall advise the Purchaser what disposition is to be made of the defective material. The Contractor shall pay all freight charges. (S. S. 6-c.) 1919.

(d) If Purchaser is to make inspection at point of production, it shall be so stated. (S. S. 6-d.) 1917.

13. *Tests.*

(b) Contractor shall give the Purchaser sufficient notice of time when material will be ready for testing. (S. S. 7-b.) 1919.

(c) Contractor shall provide, at point of production, apparatus and labor for making the required tests under supervision of the Purchaser. (S. S. 7-c.) 1919.

10. Operation.—Continued.

(d) For two-element coded relays the above readings shall be made with ideal phase relations between the currents in the two windings.

(e) For two-element line relays the above readings shall be made with phase relations between the two windings which supply mate conditions as specified on supplier's sheet.

11. Operating data.

(a) Each relay shall bear a metal name plate on which is stated:

1. Rated volts and amperes at terminals of each element.
2. Frequency.

(b) The following additional data shall be stated on either metal name plate or a paster:

1. Manufacturer's name.
2. Type.
3. Serial number.
4. Type of external device.
5. Volts, including external device.

(c) Both metal name plate and paster shall be so located that they can be readily seen when the relay is in its operating position.

12. Inspection.

(a) Purchaser may inspect the material at all stages of manufacture. (S. 3, 6-a.)

(b) Purchaser may inspect the completed product to determine that the requirements of this specification have been met. (S. 3, 6-b.)

(c) If the material has not been accepted at point of production, and if upon arrival at destination, it does not meet the requirements of this specification, it may be rejected, and the Contractor upon request, shall advise the Purchaser what disposition is to be made of the defective material. The Contractor shall pay all freight charges. (S. 3, 6-c.)

(d) If Purchaser is to make inspection at point of production, it shall be so stated. (S. 3, 6-d.)

13. Tests.

(b) Contractor shall give the Purchaser sufficient notice of time when material will be ready for testing. (S. 3, 7-b.)

(c) Contractor shall provide, at point of production, apparatus and labor for making the required tests under supervision of the Purchaser. (S. 3, 7-c.)

13. *Tests.*—Continued.

(d) Tests enumerated below shall be made on all the relays:

1. Dielectric strength:
   - (a) Windings to ground.
   - (b) Between windings.
   - (c) Between all terminal posts of contacts and ground.
   - (d) Twice rated potential applied to terminals of each winding.
2. Clearance of moving parts.
   - (a) Radial.
   - (b) Longitudinal.
   - (c) Minimum end play of moving element.
3. Electrical operation:
   - (a) Voltage to pick up contacts.
   - (b) Voltage to drop-away point.
   - (c) Voltage for normal operation with contacts at rated pressure.
   - (d) Per cent. of "pickup" voltage at which contacts open by gradual reduction of voltage of control element, as specified in section 10 ..... 1919.

14. *Sealing.*

(a) The enclosure containing the moving parts of the relay shall be sealed with the Manufacturer's seal. 1916.

15. *Packing.*

(a) Material shall be so prepared as to permit convenient handling and to protect against loss or damage during shipment. (S. S. 8-a.) 1919.

16. *Marking.*

(a) Purchaser's order, requisition and package number, name of Consignor and name and address of Consignee, shall be plainly marked on outside of package. (S. S. 9-a.) 1919.

(b) Detail list of loose pieces, containers and their contents, shall be furnished for each shipment. Where car-load shipments are made, routing and car identification shall be shown. (S. S. 9-b.) 1919.

(c) Where car-load shipments are made, name and address of Consignee may be omitted. (S. S. 9-c.) 1919.

17. *Warranty.*

(a) Contractor shall warrant the material covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obliga-

13. Tests.—Continued.

(d) Tests enumerated below shall be made on all [illegible] relays:

1. Dielectric strength:
(a) Windings to ground.
(b) Between windings.
(c) Between all terminal posts of contacts and ground.
(d) Twice rated potential applied to terminals of each winding.
2. Clearance of moving parts.
(a) Radial.
(b) Longitudinal.
(c) Minimum end play of rocking element.
3. Electrical operation.
(a) Voltage to pick up armature.
(b) Voltage to drop-away point.
(c) Voltage for normal operation with contacts at rated pressure.
(d) Per cent. of "drop" voltage at which contacts open by gradual reduction of voltage or control element, as specified in section [illegible].

14. Sealing.

(a) The enclosure containing the moving parts of the relay shall be sealed with the Manufacturer's seal.

15. Packing.

(a) Material shall be so prepared as to permit convenient handling and to protect against loss or damage during shipment.

16. Marking.

(a) Purchaser's order, requisition and package number, name of Consignor and name and address of Consignee, shall be plainly marked on outside of package.

(b) Detail list of loose pieces, containers and their contents, shall be furnished for each shipment. Waste car load shipments are made, routing and car identification shall be shown.

(c) Where car-load shipments are made, name and address of Consignee may be omitted.

17. Warranty.

(a) Contractor shall warrant the material covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obliga-

17-a. *Warranty.*—Continued.

tion under this warranty being limited to making, at point of production, any part or parts to replace those which shall be found defective within one (1) year after shipment to the Purchaser. This warranty shall not apply to any apparatus which shall have been repaired or altered in any way by anyone other than the Manufacturer thereof, so as to, in the Contractor's judgment, affect its proper functioning or reliability, nor which has been subject to misuse, negligence or accident. (S. S. 10-a.) 1919.

18. *Requisites for alternating current relays A. R. A. specification.* 1919.

(a) Purchaser to fill in such items as he desires to specify. Contractor to fill in all other blanks, so that the requisite sheet will be complete when finally submitted with Contractor's quotation. 1919.

(b) Identification. Relays covered by this sheet are for ..... Railroad on inquiry ..... order ..... Requisition ..... 1917.

(c) Relays to be furnished in accordance with the following drawings:

.....

.....

1919.

(d) Type.

1. Non-selective with respect to frequency.
   - (a) Vane .....
   - (b) Iron galvanometer .....
   - (c) Ironless galvanometer .....
   - (d) Induction motor { Shell rotor } ..... { Iron rotor } .....
   - (e) Z-Armature .....
   - (f) Tractive magnet .....
   - (g) Electropneumatic* .....

2. Selective with respect to frequency.
   - (a) Vane frequency.
   - (b) Centrifugal frequency .....

1919.

*For specifications covering the pneumatic features of this relay, see R. S. A. specifications for electropneumatic interlocking. 1919.

*For specifications covering (a) domestic features of this type, see R. S. A. specifications for electropneumatic interlocking. 1919

18. *Requisites for alternating current relays, A. R. A. specification.* Continued.

(e) Characteristics.

1. Manufacturer's name .....
2. Catalogue reference .....
3. Track .....
4. Line .....
5. Time required to open contact after de-energization of relay — Contact No. 1 ..... " " 2 ..... " " 3 ..... " " 4 .....
6. Time required to close contact after de-energization of relay — Contact No. 1 ..... " " 2 ..... " " 3 ..... " " 4 .....
7. Time required to open contact after energization of relay — Contact No. 1 ..... " " 2 ..... " " 3 ..... " " 4 .....
8. Time required to close contact after energization of relay — Contact No. 1 ..... " " 2 ..... " " 3 ..... " " 4 .....
9. Single element .....
10. Double element .....
11. Double element: Split phase .....
12. Double element: Series connection .....
13. Connection of controlled element to line — Direct ..... ; ..... ; Series device .....
14. Two-phase .....
15. Three-phase .....
16. Two-position .....
17. Three-position by reverse operation .....
18. Three-position by consecutive operation .....
19. Power.
    (a) Rated input at relay terminals.
        1. Control element — Volts ..... ; Amperes ..... ; V. A. ..... ; Watts ..... ; P. F. .....

18. Requisites for alternating current relays A. R. A. specification
Continued

(a) Characteristics

1. Manufacturer's name
2. Catalogue reference
3. Type
4. Line
5. Time required to open Contacts No. 1 " " 2 " " 3 " " 4
6. Time required to close Contacts No. 1 " " 2 " " 3 " " 4
7. Time required to open Contact No. 1 " " 2 " " 3 " " 4
8. Time required to close Contact No. 1 " " 2 " " 3 " " 4
9. Single element
10. Double element
11. Double element: Split phase
12. Double element: Series connection
13. Connection of contacted element to line — Direct / Series Parallel
14. Two-phase
15. Three-phase
16. Two-position
17. Three-position by reverse operation
18. Three-position by consecutive operation
19. Power:

(a) Rated input at relay (normal)

1. Control element — Volts / Amperes / V. A. / Watts / P. F.

18-e. *Requisites for alternating current relays, A. R. A. specification.* Continued.

2. Local element { Volts ..... / Amperes ..... / V. A. ..... / Watts ..... / P. F. ..... }

3. Third element { Volts ..... / Amperes ..... / V. A. ..... / Watts ..... / P. F. ..... }

(b) Input to relay circuits including external devices.

1 Control circuit { Volts ..... / Amperes ..... / V. A. ..... / Watts ..... / P. F. ..... }

2. Local circuit { Volts ..... / Amperes ..... / V. A. ..... / Watts ..... / P. F. ..... }

3. Third circuit { Volts ..... / Amperes ..... / V. A. ..... / Watts ..... / P. F. ..... }

20. Rated frequency .....

21. Shall relay be immune to d.c.? .....

22. Shall relay be immune to a.c. of ..... frequency? .....

23. Track relay to be unaffected by the following values of propulsion current { Surge ..... amps. / for ..... secs. / continuous .....amps. }

24. Contacts.

(a) Independent { Front ..... / Back ..... / De-energized ..... }

(b) Non-independent { Front and de-energized ..... / Back and de-energized ..... }

18-a. Requiring for alternating current relays, A. R. A. specification. Continued.

a. Local element	Volts	
	Amperes	
	V. A.	
	Watts	
	P. F.	
3. Third element	Volts	
	Amperes	
	V. A.	
	Watts	
	P. F.	

(b) Input to relay circuits including external devices

c. Control circuit	Volts	
	Amperes	
	V. A.	
	Watts	
	P. F.	
d. Local circuit	Volts	
	Amperes	
	V. A.	
	Watts	
	P. F.	
3. Third element	Volts	
	Amperes	
	V. A.	
	Watts	
	P. F.	

20. Rated frequency
21. Shall relay be immune to d.c.?
22. Shall relay be immune to a.c. of frequency?
23. Track relay to be unaffected by the following values of prohibited current

Surge	...	...	Amps.
for	...	...	sec.
continuous	...	...	amps.

24. Contacts.

(a) Independent	Front	
	Back	
	De-energized	
(b) Non-independent	Front and de-energized	
	Back and de-energized	

18-e. *Requisites for alternating current relays, A. R. A. specification.* Continued.

(c) Continuous carrying capacity ..... amps.

(d) To open circuit of { ..... amp. at ..... volt d.c. ..... amp. at ..... volt a.c. }

25. Flexible connections continuous carrying capacity ..... amps.

26. Inclosure for contacts { Ventilated ..... Non-ventilated ..... }

27. Special requisites.

.....

..... 1916.

(f) Weight.

1. Total net weight .....
2. Total shipping weight ..... 1919.

(g) Inspection or tests.

1. Shall inspections or tests be made at point of production under supervision of Purchaser? ..... 1917.
2. ..... days' notice required by Purchaser before apparatus will be ready for inspection or tests. 1916.
3. Shall inspection or tests be made at destination by Purchaser? ..... 1918.
4. Shall records of inspection and tests as furnished by Contractor be accepted? ..... 1919.

(x) Remarks.

.....

.....

..... 1916.

(y) Signed ..... 1916.

(z) Date ..... 1916.

18-e. Memoranda for information entered under A, B, C, specifications. Continued

(c) Continuous carrying capacity.

(d) To open circuit at

xg. Portable connections continuous carrying capacity.

xh. Inclosure for contacts

xi. Special requisites.

(f) Weight.

1. Total net weight

2. Total shipping weight

(g) Inspection or tests.

1. Shall inspections or tests be made at point of production under supervision of Purchaser?

2. days' notice required by Purchaser before apparatus will be ready for inspection or tests.

3. Shall inspection or tests be made at destination by Purchaser?

4. Shall records of inspection and tests be furnished to Purchaser be accepted?

(x) Remarks:

(y) Signed

(z) Place

SPECIFICATION FOR ALTERNATING CURRENT MOTOR SEMAPHORE SIGNAL.

1919.

(Official Approval May, 1920.)

1. *Requisite sheet.*

(a) Requisite sheet, section 23, attached to this specification, shall form a part thereof. (S. S. 4-a.) 1919.

(b) Where blanks have not been filled, or where an option is permitted and no preference stated, the Contractor's recommended practice shall be followed. (S. S. 4-b.) 1919.

2. *Tender.*

(a) The tender shall be for apparatus meeting the requirements of this specification. If the Contractor wishes to vary from the specification a tender may be submitted covering the apparatus he desires to furnish. This tender shall be accompanied by full information showing wherein the requirements of the specification are varied from. (S. S. 3-a.) 1919.

3. *Mechanism housing.*

(a) Mechanism housing shall be weather-proof. Doors shall be of ample size and suitably arranged for convenient and ready access to the mechanism. Means shall be provided for sufficient ventilation. 1918.

(b) Convenient means shall be provided for bringing electrical connections from the pole to the mechanism cases when latter are located at the top of the mast, and for making a good mechanical connection where the wires enter the case. 1918.

4. *Masts.*

(a) Masts shall be as specified on requisite sheet. 1918.

5. *Semaphore spectacle.*

(a) Semaphore spectacle shall be as specified on requisite sheet. If the maximum torque of the spectacle and blade specified exceeds torque curve, R. S. A. 1064, the excess torque shall be compensated for by counterweighing the spectacle. 1918.

6. *Roundels.*

(a) Roundels shall be in accordance with R. S. A. specification and shall be of the color and size shown on requisite sheet. 1918.

SPECIFICATION FOR ALTERNATING CURRENT MOTOR SEMAPHORE SIGNAL

(Official Approval May, 1920.)

1. Requisite sheet.

(a) Requisite sheet, section 23, attached to this specification, shall form a part thereof. (S. S. 4-a.) 1919.

(b) Where blanks have not been filled, or where an option is permitted and no preference stated, the Contractor's recommendation(s) practice shall be followed. (S. S. 4-b.) 1919.

2. Tender.

(a) The tender shall be for apparatus meeting the requirements of this specification. If the Contractor wishes to vary from the specification a tender may be submitted covering the apparatus he desires to furnish. This tender shall be accompanied by full information showing wherein the requirements of the specification are varied from. (S. S. 4-c.) 1919.

3. Mechanism Housing.

(a) Mechanism housing shall be weather proof. Doors shall be of ample size and suitably arranged for convenient and ready access to the mechanism. Means shall be provided for sufficient ventilation. 1919.

(b) Conventional means shall be provided for bringing electrical connections from the pole to the mechanism case when latter are located at the top of the mast, and for making a good mechanical connection where the wires enter the case. 1919.

4. Mast.

(a) Mast shall be as specified on requisite sheet. 1919.

5. Semaphore spectacle.

(a) Semaphore spectacle shall be as specified on requisite sheet. If the maximum letter of the spectacle and blade specified exceeds coupe curve, R. S. A. 1919, the excess coupe must be compensated for by counterweighing the apparatus. 1919.

6. Roundels.

(a) Roundels shall be in accordance with R. S. A. specification and shall be of the color and size shown on requisite sheet. 1919.

7. *Operating connection mechanism at base of mast.*

(a) Operating connection of the pull clear type shall have tensile strength of not less than fifteen hundred (1500) pounds. Material to be used shall be such as will not be injuriously affected by atmospheric conditions. Suitable connections shall be provided at each end, one of which shall have means of adjustment. 1918.

(b) Operating connection of push clear type shall be three-fourths (¾) inch iron pipe or its equivalent in mechanical strength; material used shall be such as will not be injuriously affected by atmospheric conditions. Suitable connectors shall be provided at each end, one of which shall have means for adjustment. The distance between guides shall be not more than eleven (11) feet. 1918.

8. *Bearings.*

(a) Bearings shall be of ample dimensions to insure reasonable durability. 1918.

(b) Means shall be provided for necessary lubrication of bearing surfaces. 1918.

(c) The semaphore bearings shall be so constructed as to prevent the entrance of water. 1918.

(d) All exposed oil holes shall be provided with weather-proof oil cups or covers. 1918.

(e) The diameter of the outer end of the boss of the semaphore bearing shall be not more than one and three-fourths (1¾) inch larger than the outside diameter of the bearing. 1918.

9. *Semaphore shaft.*

(a) The semaphore shaft shall be made of steel not less than one (1) inch square or one and one-fourth (1¼) inches in diameter, except the outer end, which shall take the spectacle specified on requisite sheet. 1918.

10. *Mechanism.*

(a) The movement of the arm when returning to a restrictive position shall be so controlled as to prevent any undue strain from being imposed upon the mechanism. 1918.

(b) The torque applied at semaphore shaft with spectacle removed, necessary to maintain the movement of the mechanism of the drive back type at any position in its arc of travel, shall not exceed five (5) foot pounds. When this mechanism is located at base of mast, additional counter torque load due to operating connections shall be compensated for. 1918.

10. *Mechanism.*—Continued.

(c) Gears shall be so protected as to minimize the likelihood of foreign matter interfering with them. 1918.

11. *Circuit controller.*

(a) Circuit controller contacts shall be self-cleaning, or they shall be made of non-corrosive materials and shall be so located as to minimize the likelihood of the contacts not performing their functions on account of foreign substances falling between them. 1918.

(b) In addition to the regular contacts for controlling the signal motor and hold clear device, the circuit controller shall be equipped with contacts for controlling external circuits, as specified on requisite sheet. 1918.

(c) If contacts for pole changing are required, they shall be arranged as specified on requisite sheet. 1918.

12. *Terminal board.*

(a) Terminal board shall be made of treated hard wood not less than one-half (½) inch thick or as specified on requisite sheet. 1918.

(b) Terminal board shall be located so as to be easily accessible. 1918.

13. *Wiring.*

(a) Wiring shall be neatly arranged and securely fastened. 1918.

(b) Stranded insulated wire not less than No. 16 A. W. G. shall be used for internal wiring of signal case. 1918.

(c) Wires shall be provided with eyelets at each end. 1918.

(d) A wiring or connecting diagram shall be located in a conspicuous place in the signal case. 1918.

14. *Motor.*

(a) Motor shall operate at the voltage, phase and frequency specified on requisite sheet. 1918.

(b) Motor shall be capable of starting the semaphore at any point in its arc with thirty-three (33) per cent. excess torque at rated voltage and frequency. 1918.

(c) Motor shall be capable of starting the spectacle and blade from rest at any point in its arc when a voltage of fifteen (15) per cent. under rated voltage is impressed upon the motor terminals, the frequency being normal and the torque complying with torque curve, R. S. A. 1064. 1918.

10. Mechanism.—Continued.

(c) Cases shall be so protected as to minimize the likelihood of foreign matter interfering with them. 1918.

11. Circuit controller.

(a) Circuit controller contacts shall be self-cleaning or they shall be made of non-corrosive materials and shall be so located as to minimize the likelihood of the contacts not performing their functions on account of foreign substances falling between them. 1918.

(b) In addition to the regular contacts for controlling the signal motor and bell clear device, the circuit controller shall be equipped with contacts for controlling external circuits, as specified on requisite sheet. 1918.

(c) If contacts for pole changing are required, they shall be arranged as specified on requisite sheet 1918

12. Terminal board.

(a) Terminal board shall be made of treated hard wood not less than one-half (½) inch thick or as specified on requisite sheet. 1918

(b) Terminal board shall be located so as to be easily accessible. 1918.

13. Wiring.

(a) Wiring shall be neatly arranged and securely fastened. 1918.

(b) Stranded insulated wire not less than No. 16 A. W. G. shall be used for internal wiring of signal case. 1918.

(c) Wires shall be provided with eyelets at each end. 1918.

(d) A wiring or connecting diagram shall be located in a conspicuous place in the signal case. 1918.

14. Motor.

(a) Motor shall operate at the voltage, phase and frequency specified on requisite sheet. 1918.

(b) Motor shall be capable of starting the semaphore at any point in its arc with thirty-two (32) per cent. excess torque at rated voltage and frequency 1918.

(c) Motor shall be capable of starting the specified and blade from rest at any point in its arc when a voltage of fifteen (15) per cent. under rated voltage is impressed upon the motor terminals, the frequency being normal and the torque complying with torque curve, R. S. A. 1918.

14. *Motor.*—Continued.

(d) Motor and mechanism of the drive back type should start back toward the stop position when the voltage impressed on the motor is reduced to sixty (60) per cent. of the minimum voltage required to start it toward the proceed position from the same point in its arc, the counter torque being not less than required by torque curve, R. S. A. 1064, and the frequency being normal. 1918.

(e) No centrifugal electrical cutouts shall be employed for starting the motor. 1918.

(f) Motor shall be so designed that foreign matter will not enter, or wear take place to such an extent as to cause an unsafe condition. 1918.

(g) The operating characteristics of the motor shall be as shown on requisite sheet. 1918.

(h) In the assembled motor of the drive back type of mechanism, all moving parts, except bearings and contacts, shall be separated by not less than twenty-five thousandths (.025) inch. The guaranteed minimum end play of moving parts shall be ten thousandths (.010) inch. 1918.

15. *Hold clear device.*

(a) Hold clear device of the induction motor type shall be subject to the same clearance requirements as stated for the signal motor. 1918.

(b) The hold clear device shall hold the signal in its proceed or caution position at rated frequency and the torque as per torque curve, R. S. A. 1064, at any voltage at which the motor will clear the signal. 1918.

(c) The hold clear device and mechanism shall be so constructed that it will release and allow the signal to assume its restrictive position when the voltage between terminals of the hold clear winding is reduced to thirty (30) per cent. of the rated voltage, the semaphore torque complying with torque curve, R. S. A. 1064, and frequency being normal. 1918.

(d) Hold clear devices of the tractive magnet type shall have an air gap between armature and magnet cores of not less than fifteen thousandths (.015) inch, and this gap shall be maintained by a positive and durable stop. The construction shall be such that there will be no undue accumulation of lubricating oil in the air gap. Magnet coils shall be so applied and connected that they can be easily replaced. 1918.

(e) The lead wires of magnet coils shall be not smaller than No. 18 A. W. G. stranded copper wire. 1918.

14. Motor.—Continued

(d) Motor and mechanism of the drive back type should start back toward the stop position when the voltage impressed on the motor is reduced to sixty (60) per cent. of the minimum voltage required to start it toward the proved position from the same point in its arc. The counter torque being not less than required by torque curve, R. S. A. 1904, and the frequency being normal. 1918.

(e) No centrifugal electrical governors shall be employed for starting the motor 1918.

(f) Motor shall be so designed that foreign matter will not enter, or wear take place to such an extent as to cause an unsafe condition 1918.

(g) The operating characteristics of the motor shall be as shown on requisite sheet. 1918

(h) In the assembled motor of the drive back type of mechanism, all moving parts, except bearings and contacts, shall be separated by not less than twenty-five thousandths (.025) inch. The guaranteed maximum end play of moving parts shall be ten thousandths (.010) inch. 1918.

15. Hold clear device.

(a) Hold clear device of the induction motor type shall be subject to the same clearance requirements as stated for the signal motor. 1918

(b) The hold clear device shall hold the signal in the proceed or caution position at rated frequency and the torque as per torque curve R. S. A. 1904, at any voltage at which the motor will clear the signal. 1918

(c) The hold clear device and mechanism shall be so constructed that it will release and allow the signal to assume its restrictive position when the voltage between terminals of the hold clear winding is reduced to thirty (30) per cent. of the rated voltage, the semaphore torque corresponding with curve, R. S. A. 1904, and frequency being normal. 1918.

(d) Hold clear devices of the inductive magnet type shall have an air gap between armature and magnet cores of not less than fifteen thousandths (.015) inch, and this gap shall be maintained by a positive and durable stop. The construction shall be such that there will be no undue accumulation of lubricating oil in the air gap. Magnet coils shall be so applied and connected that they can be easily replaced. 1918

(e) The lead wires of magnet coils shall be not smaller than No. 18 A. W. G. stranded copper wire. 1918

16. *Dielectric requirements.*

(c) A surface leakage of not less than one-fourth (¼) inch shall be provided between any exposed metallic part of the mechanism carrying current and any other metallic part thereof (motor commutator excepted). 1917.

(d) A potential of twice the normal operating requirements at a suitable frequency shall be impressed across the windings without any excessive flow of current indicating a short circuit. (G. E. R. 30-d.) 1919.

(e) Separate motor windings which are insulated from each other shall withstand a potential test between their terminals of one thousand (1000) volts a.c. plus twice the rated potential of the circuit to which the windings are connected for one (1) minute. All motor windings shall withstand a potential test between their terminals and other metal parts from which these windings are insulated of one thousand (1000) volts a.c. plus twice the rated potential of the circuit to which the windings are connected for one (1) minute. 1918.

17. *Insulation.*

(a) Coils and windings shall be of cotton or silk-covered wire, impregnated; of enameled wire, or as shown on requisite sheet. Enameling or impregnation shall be in accordance with R. S. A. specification. (G. E. R. 32-a.) 1919.

(b) Material used for insulation shall be such as will not be injuriously affected by atmospheric conditions. (G. E. R. 32-b.) 1917.

18. *Inspection.*

(a) Purchaser may inspect the material at all stages of manufacture. (S. S. 6-a.) 1919.

(b) Purchaser may inspect the completed product to determine that the requirements of this specification have been met. (S. S. 6-b.) 1919.

(c) If the material has not been accepted at point of production, and if, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected and the Contractor, upon request, shall advise the Purchaser what disposition is to be made of the defective material. The Contractor shall pay all freight charges. (S. S. 6-c.) 1919.

16. Dielectric requirements.

(a) A surface leakage of not less than one-tenth (1/10) inch shall be provided between any exposed metallic part of the mechanism carrying current and any other metallic part thereof (motor commutator excepted). (S. R. 30-c.) 1919.

(b) A potential of twice the normal operating requirements at a suitable frequency shall be impressed across the windings without any excessive flow of current indicating a short circuit. (S. R. 30-d.) 1919.

(c) Separate motor windings which are insulated from each other shall withstand a potential test between their terminals of one thousand (1000) volts a.c. plus twice the rated potential of the circuit to which the windings are connected for one (1) minute. All motor windings shall withstand a potential test between their terminals and other metal parts from which those windings are insulated of one thousand (1000) volts a.c. plus twice the rated potential of the circuit to which the windings are connected for one (1) minute. 1919.

17. Insulation.

(a) Coils and windings shall be of cotton or silk-covered wire, impregnated; of enameled wire, or as shown on requisite sheet. Enameling or impregnation shall be in accordance with R. S. A. specification.
(S. E. R. 32-a.) 1919.

(b) Material used for insulation shall be such as will not be injuriously affected by atmospheric conditions.
(S. E. R. 32-b.) 1919.

18. Inspection.

(a) Purchaser may inspect the material at all stages of manufacture. (S. S. 5-a.) 1919.

(b) Purchaser may inspect the completed product to determine that the requirements of this specification have been met. (S. R. 5-b.) 1919.

(c) If the material has not been accepted at point of production, and it, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected and the Contractor, upon request, shall advise the Purchaser what disposition is to be made of the defective material. The Contractor shall pay all freight charges. (S. S. 5-c.) 1919.

18. *Inspection.*—Continued.

(d) If Purchaser is to make inspection at point of production, it shall be so stated. (S. S. 6-d.) 1919.

19. *Tests.*

(a) Tests may be made at point of production, or on samples submitted, and may also be made at destination. (S. S. 7-a.) 1919.

(b) Contractor shall give the Puchaser sufficient notice of time when material will be ready for testing. (S. S. 7-b.) 1919.

(c) Contractor shall provide, at point of production, apparatus and labor for making the required tests under supervision of the Purchaser. (S. S. 7-c.) 1919.

(d) Tests shall be made as specified on requisite sheet. 1917.

(e) Tests enumerated below shall be made on all the signals. 1919.

1. Dielectric strength:
   - (a) Windings to ground. 1918.
   - (b) Between windings. 1918.
   - (c) Between all terminal posts of circuit controller and ground. 1918.
   - (d) Twice rated potential applied to terminals of windings. 1918.

*2. Current required by motor at rated voltage and frequency. 1918.

3. Minimum operating current and voltage of motor at rated frequency and normal torque. 1918.

*4. Current required by hold clear device at rated voltage and frequency and normal torque. 1918.

5. Minimum operating current and voltage for hold clear device at rated frequency and normal torque. 1918.

*6. Time to clear signal at rated voltage and frequency and normal torque. 1918.

7. Minimum clearance between moving and fixed parts of motor and hold clear device of the drive back type of mechanism. 1918.

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*Values may vary ten (10) per cent. above or below those specified.

18. Inspection—Continued

(d) If Purchaser is to make inspection at point of production, it shall be so stated. (S. 9, 6 d.) 1919.

19. Tests.

(a) Tests may be made at point of production, or on samples submitted and may also be made at destination. (S. 9, 7-a.) 1919.

(b) Contractor shall give the Purchaser sufficient notice of time when material will be ready for testing. (S. 9, 7-b.) 1919.

(c) Contractor shall provide, at point of production, apparatus and labor for making the required tests under supervision of the Purchaser. (S. 9, 7-c.) 1919.

(d) Tests shall be made as specified in requisite sheet 1917.

(e) Tests enumerated below shall be made on all the signals 1919.

1. Dielectric strength:
   (a) Windings to ground 1918.
   (b) Between windings 1918.
   (c) Between all terminal coils of circuit controller and ground. 1918.
   (d) Twice rated potential applied to terminals of windings. 1918.
*2. Current required by motor at rated voltage and frequency. 1918.
3. Minimum operating current and voltage of motor at rated frequency and normal for use. 1918.
*4. Current required by hold clear device at rated voltage and frequency and normal torque. 1918.
5. Minimum operating current and voltage for hold clear device at rated frequency and normal torque. 1918.
*6. Time to clear signal at rated voltage and frequency and normal torque. 1918.
7. Minimum clearance between moving and fixed parts of motor and hold clear device at the drive back type of mechanism. 1918.

*Values may vary ten (10) per cent above or below those specified.

19. *Tests.*—Continued.

(f) The following test shall be made on the first two (2) signals of new characteristics: 1919.

1. Watts required by motor at rated voltage and frequency and normal torque. 1918.
2. Watts required by hold clear device at rated voltage and frequency and normal torque. 1918.
3. Ability of motor to start from any point in its arc with thirty-three (33) per cent. excess torque at rated voltage and normal frequency. 1918.
4. Current and watts required by motor when clearing signal with thirty-three (33) per cent. excess torque at rated voltage and normal frequency. 1918.

20. *Packing.*

(a) Material shall be so prepared as to permit convenient handling and protect against loss or damage during shipment. (S. S. 8-a.) 1919.

21. *Marking.*

(a) Purchaser's order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of package. (S. S. 9-a.) 1919.

(b) Detail list of loose pieces, containers and their contents shall be furnished for each shipment. Where car-load shipments are made, routing and car identification shall be shown. (S. S. 9-b.) 1916.

(c) Where car-load shipments are made, name and address of Consignee may be omitted. (S. S. 9-c.) 1919.

22. *Warranty.*

(a) Contractor shall warrant the material covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to making, at point of production, any part or parts to replace those which shall be found defective within one (1) year after shipment to the Purchaser. This warranty shall not apply to any apparatus which shall have been repaired or altered in any way by anyone other than the Manufacturer thereof, so as to, in the Contractor's judgment, affect its proper functioning or reliability, nor which has been subject to misuse, negligence or accident. (S. S. 10-a.) 1919.

23. *Requisites for alternating current motor semaphore signal, A. R. A. specification.*

(a) Purchaser to fill in such items as he desires to specify. Contractor to fill in all blanks, so that the requisite sheet will be complete when finally submitted with Contractor's quotations. 1918.

(b) Identification: Signals covered by this sheet are for ..... Railroad on inquiry ..... Order ..... Requisition ..... 1918.

(c) Signals shall be in accordance with the following drawings:

1. Masts:
   - (a) Ground — R. S. A. 1035 or ..... 1918.
   - (b) Bracket — R. S. A. 1032 or ..... 1918.
   - (c) " — R. S. A. 1039 or ..... 1918.
   - (d) " — R. S. A. 1033 or ..... 1918.
2. Pinnacle — R. S. A. 1050 or ..... 1918.
3. Base — R. S. A. 1034 or ..... 1918.
4. " — R. S. A. 1036 or ..... 1918.
5. " — R. S. A. 1038 or ..... 1918.
6. Ladder — R. S. A. 1026 or ..... 1918.
7. " — R. S. A. 1027 or ..... 1918.
8. " — R. S. A. 1028 or ..... 1918.
9. " — R. S. A. 1029 or ..... 1918.
10. Ladder foundation — R. S. A. 1052 or ..... 1918.
11. Semaphore spectacle — R. S. A. 1040 or ..... 1918.
12. " " — R. S. A. 1041 or ..... 1918.
13. " " — R. S. A. 1233 or ..... 1918.

25. Requisites for alternating current motor semaphore signal, A. R. A. specifications.

(a) Purchaser to fill in such items as he desires to specify. Contractor to fill in all blanks, so that the requisite sheet will be complete when finally submitted with Contractor's quotations. 1918.

(b) Identification. Signals covered by this sheet are for ..... Railroad on inquiry ..... Order ..... Requisition ..... 1918.

(c) Signals shall be in accordance with the following drawings:

1 Mast:

(a) Ground R. S. A. 1095 or ... 1918.

(b) Bracke R. S. A. 1096 or ... 1918.

(c) " R. S. A. 1099 or ... 1918.

(d) " R. S. A. 1015 or ... 1918.

2 Pinnacle R S A. 1096 or ... 1918.

3 Base R S. A. 1004 or ... 1918.

4 " R. S. A. 1096 or ... 1918.

5 " R. S. A. 1098 or ... 1918.

6. Ladder R S A 1096 or ... 1918.

7 " R S A. 1097 or ... 1918.

8 " R S. A. 1098 or ... 1918.

9 " R S A. 1099 or ... 1918.

10. Ladder foundation R S A. 1099 or ... 1918.

11. Semaphore spectacle R. S. A. 1040 or ... 1918.

12. " " R S. A. 1041 or ... 1918.

13. " " R S. A. 1043 or ... 1918.

23-c. *Requisites for alternating current motor semaphore signals, A. R. A. specification.*—Continued.

14. Signal blade — R. S. A. 1065 or ..... 1918.
15. Lamp — R. S. A. 1100 or ..... 1918.
16. " — R. S. A. 1101 or ..... 1918.
17. Lamp bracket — R. S. A. 1049 or ..... 1918.

(d) Type:
1. Ground. 1918.
2. Bridge or bracket. 1918.
3. Number of arms. 1918.
4. Aspect. 1918.
5. Mechanism. 1918.
(a) Top of mast. 1918.
(b) Base of mast. 1918.

(e) Blade.
1. Material ..... 1918.

(f) Roundel:
1. Diameter ..... 1918.
2. { Flat. / Convex. } 1918.
3. Color:
(a) Stop ..... 1918.
(b) Caution ..... 1918.
(c) Proceed ..... 1918.
(d) Backlight ..... 1918.
4. Size ..... 1918.

(g) Lighting:
1. Semaphore lamp:
(a) Oil. 1918.
(b) Electric { single socket / double socket } { fused. / unfused. } 1918.
(c) Convertible. 1918.
2. Incandescent lamp:
(a) Catalogue reference ..... 1918.
(b) Volts ..... 1918.
(c) Watts ..... 1918.
(d) Candle-power ..... 1918.
(e) Bulb ..... 1918.
(f) Base ..... 1918.
(g) Filament ..... 1918.
(h) Extra bulbs required..... 1918.

23-c. Requisites for alternating current motor semaphore signals.
A. R. A. Specification.—Continued.

14. Signal blade	R. S. A. 1065 or	1918.
15. Lamp	R. S. A. 1100 or	1918.
16.	R. S. A. 1101 or	1918.
17. Lamp bracket	R. S. A. 1095 or	1918.

(d) Type:

1. Ground.	1918.
2. Bridge or bracket.	1918.
3. Number of arms.	1918.
4. Aspect.	1918.
5. Mechanism.	1918.
(a) Top of mast.	1918.
(b) Base of mast.	1918.
(e) Blade.	
1. Material	1918.
(i) Roundel:	
1. Diameter	1918.
2. Color: { Flat. / Convex. }	1918.
3. Color:	
(a) Stop	1918.
(b) Caution	1918.
(c) Proceed	1918.
(d) Backlight	1918.
4. Size	1918.
(g) Lighting:	
1. Semaphore lamp:	
(a) Oil.	1918.
(b) Electric { single socket / double socket } { fluted / enclosed }	1918.
(c) Convertible.	1918.
2. Incandescent lamp:	
(a) Catalogue reference	1918.
(b) Volts	1918.
(c) Watts	1918.
(d) Candle power	1918.
(e) Bulb	1918.
(f) Base	1918.
(g) Reamer	1918.
(h) Extra bulbs required	1918.

23. *Requisites for alternating current motor semaphore signals, A. R. A. specification.*—Continued.

(h) Operating characteristics:

1. Type of motor..... 1918.
2. Frequency ..... 1918.
3. Phase ..... 1918.
4. Rated operating voltage..... 1918.
5. Minimum operating voltage..... 1918.
6. Maximum current to clear, torque curve, R. S. A. 1064 ..... 1918.
7. Maximum current to clear thirty-three (33) per cent. excess torque curve, R. S. A. 1064 ..... 1918.
8. Maximum watts torque curve, R. S. A. 1064 ..... 1918.
9. Time to clear signal at normal torque, rated voltage and frequency .....
   (a) .....° to .....° ..... sec. 1918.
   (b) .....° to .....° ..... sec. 1918.
10. Hold clear device:
   (a) Current, rated voltage and frequency ..... 1918.
   (b) Watts, rated voltage and frequency ..... 1918.
   (c) Number and kind of contacts operated by hold clear device..... 1918.

(i) Circuit controller:

1. Circuit controller contacts in addition to those required for operating signals shall be furnished as follows:
   (a) One contact open between .....° and .....°. 1918.
   (b) One contact open between .....° and .....°. 1918.
   (c) One contact closed between .....° and .....°. 1918.
   (d) One contact closed between .....° and .....°. 1918.
2. Pole changer contacts shall be furnished for changing polarity:
   (a) Between 0° and 45°. 1918.
   (b) Between 45° and 90°. 1918.
   (c) Between .....° and .....°. 1918.

(j) Terminal board shall be ..... 1918.

23. *Requisites for alternating current motor semaphore signals, A. R. A. specification.*—Continued.

(k) Insulation of coils and windings shall be ..... 1918.

(l) Counters:

1. { Shall / Shall not } be furnished. 1918.
2. To count between
   (a) .....° and .....°. 1918.
   (b) .....° and .....°. 1918.

(m) Painting:

1. Shall be in accordance with R. S. A. specification. 1918.

(n) Weight.

1. Total net weight .....
2. Total shipping weight..... 1919.

(o) Inspection or tests:

1. Shall inspections or tests be made at point of production under supervision of Purchaser? ..... 1917.
2. ..... days notice required by Purchaser before apparatus will be ready for inspection or test. 1916.
3. Shall inspection or tests be made at destination by Purchaser? ..... 1918.
4. Shall record of inspection and tests as furnished by Contractor be accepted? ..... 1919.

(x) Remarks .....
..... 1916.

(y) Signed ..... 1916.

(z) Date ..... 1916.

SPECIFICATION FOR ELECTRIC COLOR LIGHT SIGNAL.

1919.

(Official Approval May, 1920.)

1. *Requisite sheet.*

(a) Requisite sheet, section 21, attached to this specification, shall form a part thereof. (S. S. 4-a.) 1919.

(b) Where blanks have not been filled, or where an option is permitted and no preference stated, the Contractor's recommended practice shall be followed. (S. S. 4-b.) 1919.

2. *Tender.*

(a) The tender shall be for apparatus meeting the requirements of this specification. If the Contractor wishes to vary from the specification a tender may be submitted covering the apparatus he desires to furnish. This tender shall be accompanied by full information showing wherein the requirements of the specification are varied from. (S. S. 3-a.) 1919.

3. *Design.*

(a) The signal shall be of a design approved by the Purchaser. 1919.

4. *Case.*

(a) Case shall be weatherproof. 1919.

(b) Case shall be provided with hand holes or doors to give access to terminal boards and lamps. 1919.

5. *Terminal boards.*

(a) Terminal boards shall be made of treated hard wood not less than one-half (½) inch thick or as specified on requisite sheet. 1919.

(b) Terminal boards shall be located so as to be easily accessible. 1919.

6. *Wiring.*

(a) Wiring shall be neatly arranged and securely fastened. 1918.

(b) Insulated wire not less than No. 14, A. W. G. shall be used for internal wiring of case. 1919.

(c) A wiring or connecting diagram shall be located in a conspicuous place in the case. 1918.

(d) All wiring shall terminate at binding posts. 1919.

7. *Insulation.*

(b) Material used for insulation shall be such as will not be injuriously affected by atmospheric conditions. (G. E. R. 32-b.) 1917.

SPECIFICATION FOR ELECTRIC COLOR LIGHT SIGNAL

1919

(Official Approved May, 1920.)

1. Requiring Blade.

(a) Requiring blade, section 27, attached to this specification, shall form a part thereof. (S. S. 4-a) 1919

(b) Where blades have not been filed, or where an option is permitted and no preference stated, the Committee's recommended practice shall be followed. (S. S. 4-b) 1919.

2. Tender.

(a) The tender shall be for apparatus meeting the requirements of this specification. If the Contractor wishes to vary from the specification a tender may be submitted covering the apparatus he desires to furnish. This tender shall be accompanied by full information showing where in the requirements of the specification are varied from. (S. S. 3-c) 1919

3. Design.

(a) The signal shall be of a design approved by the Purchaser. 1919.

4. Case.

(a) Case shall be weatherproof. 1919.

(b) Case shall be provided with hinged doors or doors to give access to terminal boards and lamps. 1919.

5. Terminal Boards.

(a) Terminal boards shall be made of treated hard wood not less than one-half (½) inch thick or as specified on Purchase Blank. 1919.

(b) Terminal boards shall be located so as to be easily accessible. 1919.

6. Wiring.

(a) Wiring shall be neatly arranged and securely fastened. 1919.

(b) Insulated wire not less than No. 14, A. W. G. shall be used for internal wiring of case. 1919

(c) A wiring or connecting diagram shall be located in a conspicuous place in the case. 1919.

(d) All wiring shall terminate at binding posts. 1919.

7. Insulation.

(a) Material used for insulation shall be such as will not be injuriously affected by atmospheric conditions. (S. E. R. 3-b) 1919.

8. *Range.*

(a) The range in daylight under bright sunlight conditions shall be determined when lamps are operating at the wattage and candle power stated on requisite sheet. 1919.

9. *Spread.*

(a) The visual spread shall be as specified on requisite sheet. 1919.

10. *Lenses and roundels.*

(a) The size and type of lenses and roundels shall be as specified on requisite sheet. 1919.

(b) Main or objective lenses or roundels shall have a diameter of not less than five (5) inches. 1919.

(c) Lens units of the same type and manufacture shall be interchangeable. 1919.

11. *Lamps.*

(a) Lamps if furnished shall be of the type and electrical characteristics as specified on requisite sheet. 1919.

(b) The number of lamps back of each lens unit or roundel shall be as specified on requisite sheet. 1919.

12. *Mounting.*

(a) Mounting shall be adjustable so as to provide the range as stated on requisite sheet, and at the same time give as good a close range indication as other limiting conditions permit. 1919.

13. *Transformers.*

(a) Transformers mounted within and forming a part of the signal, shall meet the insulation tests prescribed in specification for single-phase, air-cooled track transformers, operated at the same voltage. They shall be provided with taps to take care of the variation in the voltage supply, as specified on requisite sheet. 1919.

14. *Reflectors.*

(a) Reflectors, if used, shall be specified on requisite sheet and shall be so arranged as not to give phantom indications. 1919.

15. *Inspection.*

(a) Purchaser may inspect the material at all stages of manufacture. (S. S. 6-a.) 1919.

(b) Purchaser may inspect the completed product to determine that the requirements of this specification have been met. (S. S. 6-b.) 1919.

(c) If the material has not been accepted at point of production, and if, upon arrival at destination, it does not meet the requirements of this specification, it may be

15-c. *Inspection.*—Continued.

rejected, and the Contractor, upon request, shall advise the Purchaser what disposition is to be made of the defective material. The Contractor shall pay all freight charges. (S. S. 6-c.) 1919.

(d) If Purchaser is to make inspection at point of production, it shall be so stated. (S. S. 6-d.) 1917.

16. *Tests.*

(a) Tests may be made at point of production, or on samples submitted, and may also be made at destination. (S. S. 7-a.) 1919.

(b) Contractor shall give the Purchaser sufficient notice of time when material will be ready for testing. (S. S. 7-b.) 1919.

(c) Contractor shall provide, at point of production, apparatus and labor for making the required tests under supervision of the Purchaser. (S. S. 7-c.) 1919.

17. *Material and workmanship.*

(a) Material and workmanship shall be first-class in every respect. (S. S. 5-a.) 1911.

18. *Marking.*

(a) Purchaser's order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of package. (S. S. 9-a.) 1919.

(b) Detail list of loose pieces, containers and their contents, shall be furnished for each shipment. Where car-load shipments are made, routing and car identification shall be shown. (S. S. 9-b. 1919.

(c) Where car-load shipments are made, name and address of Consignee may be omitted. (S. S. 9-c.) 1919.

19. *Packing.*

(a) Material shall be so prepared as to permit convenient handling and to protect against loss or damage during shipment. (S. S. 8-a.) 1919.

20. *Warranty.*

(a) Contractor shall warrant the material covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to making, at point of production, any part or parts to replace those which shall be found defective within one (1) year after shipment to the Purchaser. This warranty shall not apply to any apparatus which shall have been repaired or altered in any way by anyone other than the Manufacturer thereof, so as to, in the Contractor's judgment, affect its

20-a. *Warranty.*—Continued.

proper functioning or reliability, nor which has been subject to misuse, negligence or accident.

(S. S. 10-a.) 1919.

21. *Requisites for electric color light signal—A. R. A. specification.*

(a) Purchaser to fill in such items as he desires to specify; Contractor to fill in all other blanks, so that the requisite sheet will be complete when finally submitted with Contractor's quotation. 1917.

(b) Identification:

1. Signals covered by this sheet are for .....
Railroad on inquiry.....order.....
Requisition..... Number required.....

1919.

(c) Weight:

1. Total net weight.....
2. Total shipping weight..... 1919.

(d) Signals shall be furnished in accordance with drawings ..... 1919.

(e) Type:

Indoor.	Dwarf.
Tunnel	Bracket post.
Outdoor.	Highway bridge.
Bridge.	Suspended.
Ground.	Take siding indicator.

1919.

(f) Color of lenses: Indication..

One Arm,	One (1) color	....
	Two (2) color	....
	Three (3) color	....
Two Arm,		
Top arm,	One (1) color	....
	Two (2) color	....
	Three (3) color	....
Bottom arm,	One (1) color	....
	Two (2) color	....
	Three (3) color	....
Three Arm,		
Top arm,	One (1) color	....
	Two (2) color	....
	Three (3) color	....
Middle arm,	One (1) color	....
	Two (2) color	....
	Three (3) color	....

30-a Byrnes.—Continued

proper functioning or reliability for which has been
subject to serious negligence on section

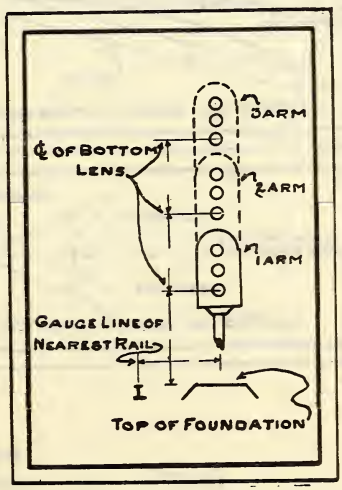
21-f. *Requisites for electric color light signal, A. R. A. specification.*—Continued.

Bottom arm, One (1) color ....
Two (2) color ....
Three (3) color ....
Dwarf, One (1) color ....
Two (2) color ....
Three (3) color ....
1919.

(g) Terminal board shall be ..... 1919.

(h) Background and hoods for outdoor signals:
1. Are these required?..... .....
2. Distance from center of lens unit to edge of background.....inches.
3. Distance from face of objective lens to front edge of hood.....inches. 1919.

(i) Diagram:



1919.

(j) Shall signal be mounted on:
1. Top of pipe?.....
2. Bracket which is bolted to pipe?.....
3. Side wall or roof of tunnel?.....
4. On foundation between tracks in tunnel?.....
1919.

21. Requirements for electric color light signal, A. R. A. specifications—Continued.

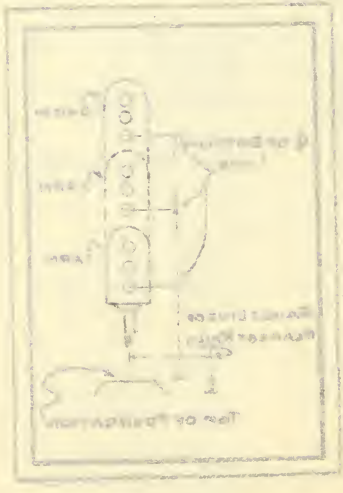
Bottom arm: One (1) color ..... Two (2) colors ..... Three (3) color .....

Dwarf: One (1) color ..... Two (2) colors ..... Three (3) colors .....

(c) Terminal board shall be ..... type.

(d) Backgrounds and hoods for outdoor signals:
1. Are these required?
2. Distance from center of lens unit to edge of background ..... inches.
3. Distance from face of objective lens to front edge of hood ..... inches.

(e) Diagram:



(f) Shall signal be mounted on:
1. Top of pipe?
2. Bracket which is bolted to mast?
3. Side wall or roof of house?
4. On foundation between tracks in runway?

21. *Requisites for electric color light signal, A. R. A. specification.*—Continued.

(k) Lenses:

1. Diameter ..... inches.

2. Transmission: R.S.A. Standard.

3. Are special lenses required to improve spread or close range indication of signal?.....

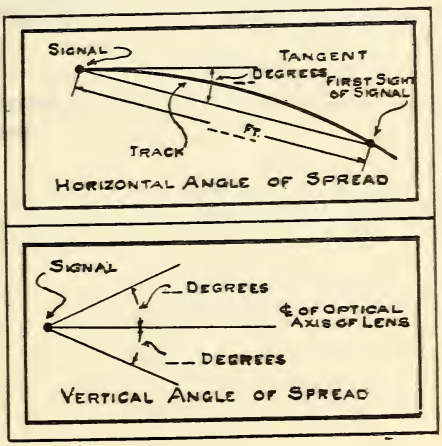
4. Special lenses { shall / shall not } be required to improve spread or close range indication of signal.

1919.

(l) Range under bright sunlight conditions.....feet.

1919.

(m) Spread:



1919.

(n) Lamps:

Voltage ..... Watts ..... C. P. .....
Life of lamps.....hrs. at.....volts.
Tungsten..... Carbon.....
Bulb..... Base.....
Number of lamps behind each lens unit.....

1919.

21. *Requisites for color light signal, A. R. A. specification.*—Con.

(o) Transformer:
Shall signal include transformer?.....
Primary volts.....Secondary volts.....
Cycles.....Capacity volt amperes.....
1919.

(p) Shall reflectors be furnished?..... 1919.

(q) Inspection or tests:

1. Shall inspection or tests be made at point of production, under supervision of Purchaser?.....
1917.

2. .....days' notice required by Purchaser before apparatus will be ready for inspection or tests.
1916.

3. Shall inspection or tests be made at destination by Purchaser?..... 1918.

4. Shall record of inspection and tests as furnished by Contractor be accepted?..... 1919.

(x) Remarks .....
.....
..... 1916.

(y) Signed ..... 1916.

(z) Date ..... 1916.

SPECIFICATION FOR ELECTRIC POSITION LIGHT SIGNAL.

1919.

(Official Approval May, 1920.)

1. *Requisite sheet.*

(a) Requisite sheet, section 24, attached to this specification shall form a part thereof. (S. S. 4-a.) 1919.

(b) Where blanks have not been filled, or where an option is permitted and no preference stated, the Contractor's recommended practice shall be followed. (S. S. 4-b.) 1919.

2. *Tender.*

(a) The tender shall be for apparatus meeting the requirements of this specification. If the Contractor wishes to vary from the specification a tender may be submitted covering the apparatus he desires to furnish. This tender shall be accompanied by full information showing wherein the requirements of the specification are varied from. (S. S. 3-a.) 1919.

3. *Design.*

(a) The signal shall be of a design approved by the Purchaser. 1919.

4. *High signal.*

(a) The high signal shall be made of lamp units. The distance between lamp unit centers shall be as specified on requisite sheet. 1919.

(b) Lamp units shall be assembled on framework to provide the aspects as specified on requisite sheet. 1919.

(c) Lamp unit receptacles shall be weatherproof. 1919.

(d) Lamp units shall be mounted in such a way that they can be adjusted individually in order to procure the alignment which will provide for satisfactory signal indications. 1919.

5. *Dwarf signal.*

(a) Dwarf signal shall consist of weather-proof iron case with necessary compartments arranged so as to provide the aspects as specified on requisite sheet. 1919.

(b) Terminal boards shall be made of treated hard wood not less than one-half (½) inch thick or as specified on requisite sheet. 1919.

(c) Terminal board shall be located so as to be easily accessible. 1919.

(d) Compartments of the signal shall be separated by light proof barriers. 1919.

(e) Lamp receptacles shall be accurately located and held rigidly in place. 1919.

SPECIFICATION FOR ELECTRIC POSITION LIGHT SIGNAL

1929

(Office Approved May, 1929)

1. Removable sheet.

(a) Recognizing short sections as allowed to this specification shall have been [illegible]

(b) Where a sheet has been filed, or where an option is permitted and no preference noted, the Committee's recommended practice shall be followed

2. Tender.

(a) The tender shall be for supplies meeting the requirements of this specification. If the Committee wishes to vary from the specification a tender may be submitted covering the apparatus he desires to furnish. This tender shall be accompanied by full information showing wherein in the requirements of the specification are varied from.

3. Lenses.

(a) The signal shall be of a design approved by the Purchaser.

4. High signal.

(a) The high signal shall be made of long units. The distance between lamp and mirrors shall be as specified on requisite sheet.

(b) Lamp rods shall be assembled on framework to provide the capacity as specified on requisite sheet.

(c) Lamp sockets shall be weatherproof.

(d) Lamp units shall be mounted in such a way that they can be adjusted individually in order to receive the alignment which will provide for satisfactory signal indications.

5. Dwarf signal

(a) Dwarf signal shall consist of weather-proof lenses with necessary compartments arranged so as to provide the aspects as specified on requisite sheet.

(b) Terminal boards shall be made of treated hard wood not less than one-half (½) inch thick or as specified on requisite sheet.

(c) Terminal board shall be located so as to be easily accessible.

(d) Connections of the signal shall be separated by light proof barriers.

(e) Lamp receptacles shall be terminals located and wired rigidly in place.

6. *Framework for high signals.*

(a) Framework shall be made of iron and designed to provide the aspects as specified on requisite sheet. 1919.

7. *Terminal box for high signals.*

(a) Iron terminal boxes shall be as specified on requisite sheet. 1919.

(b) Wires from lamp units shall be brought to terminals in the terminal box as shown by wiring diagram. 1919.

8. *Wiring.*

(a) Wiring shall be neatly arranged and securely fastened. 1918.

(b) Insulated wire not less than No. 14 A.W.G. shall be used for internal wiring of case. 1919.

(c) A wiring or connecting diagram shall be located in a conspicuous place in the case. 1918.

(d) All wiring shall terminate at binding posts. 1919.

9. *Insulation.*

(a) Material used for insulation shall be such as will not be injuriously affected by atmospheric conditions. (G. E. R. 32-b) 1917.

10. *Range.*

(a) The range in daylight under bright sunlight conditions shall be determined when lamps are operating at the wattage and candle-power stated on requisite sheet. 1919.

11. *Spread.*

(a) The visual spread shall be as specified on requisite sheet. 1919.

12. *Lens.*

(a) Lenses shall be of the type, size and focus as specified on requisite sheet. 1919.

(b) Lenses shall be made of clear flint glass. 1919.

13. *Lamps.*

(a) Lamps, if furnished, shall be of the type and electrical characteristics as specified on requisite sheet. 1919.

14. *Cover glass for high signal.*

(a) Cover glass of "no glare" tint shall be furnished with each lens. 1919.

(b) Cover glass shall be of such a shape and arranged so as to prevent false indications being given due to light reflections. 1919.

6. Framework for high signals.

(a) Framework shall be made of iron and designed to provide the aspects as specified on requisite sheet.

7. Terminal box for high signals.

(a) Iron terminal boxes shall be as specified on requisite sheet.

(b) Wires from lamp units shall be brought to terminals in the terminal box as shown by wiring diagram.

8. Wiring.

(a) Wiring shall be neatly arranged and securely fastened.

(b) Insulated wire not less than No. 14 A.W.G. shall be used for internal wiring of case.

(c) A wiring or connecting diagram shall be located in a conspicuous place in the case.

(d) All wiring shall terminate at binding posts.

9. Insulation.

(a) Material used for insulation shall be such as will not be injuriously affected by atmospheric conditions.
(C. E. R. 32-d)

10. Range.

(a) The range in daylight under bright sunlight conditions shall be determined when lamps are operating at the voltage and candle-power stated on requisite sheet.

11. Spread.

(a) The visual spread shall be as specified on requisite sheet.

12. Lens.

(a) Lenses shall be of the type, size and focus as specified on requisite sheet.

(b) Lenses shall be made of clear flint glass.

13. Lamps.

(a) Lamps, if furnished, shall be of the type and electrical characteristics as specified on requisite sheet.

14. Cover glass for high signals.

(a) Cover glass of "no glare" tint shall be furnished with each lens.

(b) Cover glass shall be of such a shape and arranged so as to prevent false indications being given due to light reflections.

15. *Reflector for high signal.*

(a) Each lamp shall be provided with a reflector installed in such a manner as to increase the spread of light in a vertical plane to improve the close range indication. 1919.

(b) Reflector shall be arranged so as not to give phantom indications. 1919.

16. *Background and hood.*

(a) A background shall be furnished for each arm of high signal. The background shall be made of black sheet iron or steel of a thickness of not less than three sixty-fourths (3/64) inch and painted a dull or flat black. The outer edges shall not come closer than eight (8) inches to the center of a light unit. 1919.

(b) A hood shall be furnished for each lamp unit of a high signal and over each lens of a dwarf signal. 1919.

(c) Hood for lamp units of a high signal shall be made of sheet iron and shall be not less than eight (8) inches long and shall extend more than half way around the lens opening. 1919.

(d) Hood for dwarf signals shall be made of iron and shall be not less than two (2) inches long and extend more than half way around the lens opening. 1919.

(e) Hood shall be designed so as to minimize the likelihood of snow and ice accumulating on the cover glass. 1919.

17. *Mounting.*

(a) Mounting shall be adjustable so as to provide the range as stated on requisite sheet, and at the same time give as good a close range indication as other limiting conditions permit. 1919.

18. *Inspection.*

(a) Purchaser may inspect the material at all stages of manufacture. (S. S. 6-a.) 1919.

(b) Purchaser may inspect the completed product to determine that the requirements of this specification have been met. (S. S. 6-b.) 1919.

(c) If the material has not been accepted at point of production, and if, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected, and the Contractor, upon request, shall advise the Purchaser what disposition is to be made of the defective material. The Contractor shall pay all freight charges. (S. S. 6-c.) 1919.

(d) If Purchaser is to make inspection at point of production, it shall be so stated. (S. S. 6-d.) 1917.

19. *Tests.*

(a) Tests may be made at point of production, or on samples submitted, and may also be made at destination. (S. S. 7-a.) 1919.

(b) Contractor shall give the Purchaser sufficient notice of time when material will be ready for testing. (S. S. 7-b.) 1919.

(c) Contractor shall provide, at point of production, apparatus and labor for making the required tests under supervision of the Purchaser. (S. S. 7-c.) 1919.

20. *Material and workmanship.*

(a) Material and workmanship shall be first-class in every respect. (S. S. 5-a.) 1911.

21. *Marking.*

(a) Purchaser's order, requisition and package number, name of Consignor and name and address of Consignee shall be plainly marked on outside of package. (S. S. 9-a.) 1919.

(b) Detail list of loose pieces, containers and their contents, shall be furnished for each shipment. Where car-load shipments are made, routing and car identification shall be shown. (S. S. 9-b.) 1919.

(c) Where car-load shipments are made, name and address of Consignee may be omitted. (S. S. 9-c.) 1919.

22. *Packing.*

(a) Material shall be so prepared as to permit convenient handling and to protect against loss or damage during shipment. (S. S. 8-a.) 1919.

23. *Warranty.*

(a) Contractor shall warrant the material covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to making, at point of production, any part or parts to replace those which shall be found defective within one (1) year after shipment to the Purchaser. This warranty shall not apply to any apparatus which shall have been repaired or altered in any way by anyone other than the Manufacturer thereof, so as to, in the Contractor's judgment, affect its proper functioning or reliability, nor which has been subject to misuse, negligence or accident. (S. S. 10-a.) 1919.

19. Tests.

(a) Tests may be made at point of production, or on samples submitted, and may also be made at destination. (S. S. 7-a.) 1919.

(b) Contractor shall give the Purchaser sufficient notice of time when material will be ready for testing. (S. S. 7-b.) 1919.

(c) Contractor shall provide, at point of production, apparatus and labor for making the required tests under supervision of the Purchaser. (S. S. 7-c.) 1919.

20. Material and workmanship.

(a) Material and workmanship shall be first-class in every respect. (S. S. 5-a.) 1919.

21. Marking.

(a) Purchaser's order, requisition and package number, name of Consignee and name and address of Consignor shall be plainly marked on outside of package. (S. S. 9-a.) 1919.

(b) Detail list of loose pieces, containers and their contents, shall be furnished for each shipment. Where carload shipments are made, routing and car identification shall be shown. (S. S. 9-b.) 1919.

(c) Where car-load shipments are made, name and address of Consignee may be omitted. (S. S. 9-c.) 1919.

22. Packing.

(a) Material shall be so prepared as to permit convenient handling and to protect against loss or damage during shipment. (S. S. 8-a.) 1919.

23. Warranty.

(a) Contractor shall warrant the material covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to making, at point of production, any part or parts to replace those which shall be found defective within one (1) year after shipment to the Purchaser. This warranty shall not apply to any apparatus which shall have been repaired or altered in any way by anyone other than the Manufacturer thereof, so as to, in the Contractor's judgment, affect its proper functioning or reliability, nor which has been subject to misuse, negligence or accident. (S. S. 10-a.) 1919.

24. *Requisites for electric position light signal, A. R. A. specification.*

(a) Purchaser to fill in such items as he desires to specify. Contractor to fill in all other blanks so that the requisite sheet will be complete when finally submitted with Contractor's quotation. 1917.

(b) Identification:

1. Signals covered by this sheet are for.....R. R. on inquiry..... Order..... Requisition..... Number required..... 1919.

(c) Weight:

1. Total net weight.....
2. Total shipping weight..... 1919.

(d) Signals are to be furnished in accordance with the following drawings..... 1919.

(e) Type:

Bridge.
Ground.
Dwarf.
Bracket Post.
Highway Bridge.
Suspended
Take siding indicator. 1919.

(f) Aspect.		Indication.
One Arm,	One (1) position	.....
	Two (2) position	.....
	Three (3) position	.....
	Four (4) position	.....
Two Arm,		
Top Arm,	One (1) position	.....
	Two (2) position	.....
	Three (3) position	.....
	Four (4) position	.....
Bottom Arm,	One (1) position	.....
	Two (2) position	.....
	Three (3) position	.....
	Four (4) position	.....
Three Arm,		
Top Arm,	One (1) position	.....
	Two (2) position	.....
	Three (3) position	.....
	Four (4) position	.....

1919.

24. Requisites for electric position light signal, A. R. A. specification.

(a) Purchaser to fill in such items as he desires to specify. Contractor to fill in all other blanks so that the requisite sheet will be complete when finally submitted with Contractor's quotation. 1917.

(b) Identification:

1. Signals covered by this sheet are for..... R. R.
on inquiry..... Order..... Requisition.....
Number required..... 1919.

(c) Weight:

1. Total net weight..... 1919.
2. Total shipping weight..... 1919.

(d) Signals are to be furnished in accordance with the following drawings
..... 1919.

(e) Type.
Bridge.
Ground.
Dwarf.
Bracket Post.
Highway Bridge.
Suspended
Take siding Indicator. 1919.

(f) Aspect.

	Indication.
One Arm.	
	One (1) position .....
	Two (2) position .....
	Three (3) position .....
	Four (4) position .....
Two Arm.	
Top Arm.	
	One (1) position .....
	Two (2) position .....
	Three (3) position .....
	Four (4) position .....
Bottom Arm.	
	One (1) position .....
	Two (2) position .....
	Three (3) position .....
	Four (4) position .....
Three Arm.	
Top Arm.	
	One (1) position .....
	Two (2) position .....
	Three (3) position .....
	Four (4) position .....

1919.

24. *Requisites for position light signals, A. R. A. specification.*—Con.

(g) Terminal boards shall be..... 1919.

(h) Shall signals be mounted on existing poles?.....; if so, state size of pipe.....inches. 1919.

(i) Terminal boxes for: { One arm signal..... / Two arm signal..... / Three arm signal..... } 1919.

(j) Height from top of foundation to common light .....feet.....inches. 1919.

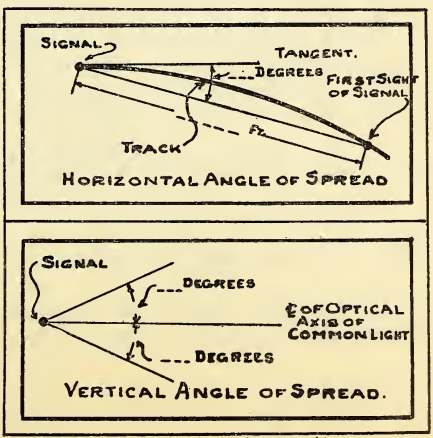
(k) Lamp Units:
1. Number of Lamp Units per indication.....
2. Distance between center of lamp units.....
1919.

(l) Lamps:
Voltage.....Watts.....C. P.....
Life of lamp.....hrs. at volts.....
Tungsten..... Type.....
Bulb..... Base.....
1919.

(m) Lenses:
Type .....
Size .....
Focal length.....inches. 1919.

(n) Range under bright sunlight conditions..... .....feet. 1919.

(o) Spread:



SKETCH X

1919.

24. Requirements for position light signals A. R. A. specification.—Cont.

(g) Terminal boards shall be..... 1919.

(h) Shall signals be mounted on existing poles?.....
if so, state size of pipe..... Inches. 1919.

(i) Terminal boxes for: { One arm signal ..... / Two arm signal ..... / Three arm signal ..... } 1919.

(j) Height from top of foundation to common light
..... feet ..... inches. 1919.

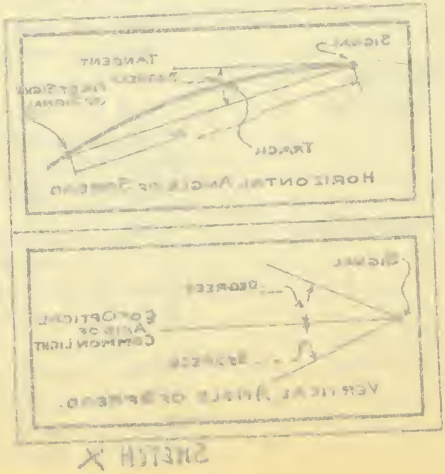
(k) Lamp Units:
1. Number of Lamp Units per indication.....
2. Distance between center of lamp units.....

(l) Lamps: 1919.
Voltage ..... Watts .....
Life of lamp ..... hrs. at volts .....
Tungsten ..... Type .....
Bulb ..... Base .....

(m) Lenses: 1919.
Type .....
Size .....
Focal length ..... inches. 1919.

(n) Range under bright sunlight conditions
..... feet. 1919.

(o) Spread:



SKETCH X

1919.

24. *Requisites for position light signals, A. R. A. specification.*—Con.

(p) Inspection or Tests:

1. Shall inspection or tests be made at point of production under supervision of Purchaser?..... 1919.

2. .....days notice required by Purchaser before apparatus will be ready for inspection or tests. 1916.

3. Shall inspection or tests be made at destination by Purchaser?..... 1918.

4. Shall record of inspection and tests as furnished by Contractor be accepted?..... 1918.

(x) Remarks .....
.....
..... 1916.

(y) Signed ..... 1916.

(z) Date ..... 1916.

24. Requisites for position light signals A. R. A. specification.—Con.

(p) Inspection or Tests:

1. Shall inspection or tests be made at point of production under supervision of Purchaser? ..... 1918.

2. ..... days notice required by Purchaser before apparatus will be ready for inspection or tests. 1918.

3. Shall inspection or tests be made at destination by Purchaser? ..... 1918.

4. Shall record of inspection and tests as furnished by Contractor be accepted? ..... 1918.

(x) Remarks .....

.....

.....

(y) Signed ..... 1918.

(z) Date ..... 1918.

STANDARD SECTIONS FOR USE IN UNIT SPECIFICATIONS.

1919.

(Official Approval May, 1920.)

1. *Purpose.**

(a) The purpose of this specification is to provide for ..... 1919.

2. *Drawings.*

(a)** Purchaser's drawings accompanying this specification and forming an essential part thereof, are as follows:
.....
.....
..... 1919.

(b)** Contractor's drawings accompanying his tender and forming an essential part thereof are as follows:....
.....
.....
..... 1919.

3. *Tender.*

(a) The tender shall be for apparatus meeting the requirements of this specification. If the Contractor wishes to vary from the specification, a tender may be submitted covering the apparatus he desires to furnish. This tender shall be accompanied by full information showing wherein the requirements of the specification are varied from. 1919.

4. *Requisite sheet.*

(a) Requisite sheet, section ....., attached to this specification, shall form a part thereof. 1919.

(b) Where blanks have not been filled, or where an option is permitted and no preference stated, the Contractor's recommended practice shall be followed. 1919.

5. *Material and workmanship.*

(a) Material and workmanship shall be first-class in every respect. 1911.

6. *Inspection.*

(a) Purchaser may inspect the material at all stages of manufacture. 1919.

(b) Purchaser may inspect the completed product to determine that the requirements of this specification have been met. 1919.

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*To be used where title does not fully describe the intent of the specification.

**Sections may be made a part of the requisite sheet.

6. *Inspection.*—Continued.

(c) If the material has not been accepted at point of production and if, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected, and the Contractor, upon request, shall advise the Purchaser what disposition is to be made of the defective material. The Contractor shall pay all freight charges. 1919.

(d) If Purchaser is to make inspection at point of production, it shall be so stated. 1917.

7. *Tests.*

(a) Tests may be made at point of production, or on samples submitted, and may also be made at destination. 1919.

(b) Contractor shall give the Purchaser sufficient notice of time when material will be ready for testing. 1919.

(c) Contractor shall provide at point of production, apparatus and labor for making the required tests under supervision of the Purchaser. 1919.

8. *Packing.*

(a) Material shall be so prepared as to permit convenient handling and to protect against loss or damage during shipment. 1919.

9. *Marking.*

(a) Purchaser's order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of package. 1919.

(b) Detail list of loose pieces, containers and their contents shall be furnished for each shipment. Where car-load shipments are made, routing and car identification shall be shown. 1919.

(c) Where car-load shipments are made, name and address of Consignee may be omitted. 1919.

10. *Warranty.*

(a) Contractor shall warrant the material covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to making, at point of production, any part or parts to replace those which shall be found defective within one (1) year after shipment to the Purchaser. This warranty shall not apply to any apparatus which shall have been repaired or altered in any way by anyone other than the Manufacturer thereof, so as to, in the Contractor's judgment, affect its proper functioning or reliability nor which has been subject to misuse, negligence or accident. 1919.

6. Inspection.—Continued

(c) If the material has not been accepted at point of production and if upon arrival at destination it does not meet the requirements of this specification, it may be rejected, and the Contractor, upon request shall advise the Purchaser what disposition is to be made of the defective material. The Contractor shall pay all freight charges.

(d) If Purchaser is to make inspection at point of production, it shall be so stated.

7. Tests.

(a) Tests may be made at point of production, or on samples submitted, and may also be made at destination.

(b) Contractor shall give the Purchaser sufficient notice of time when material will be ready for testing.

(c) Contractor shall provide at point of production, apparatus and labor for testing the replaces test upon supervision of the Purchaser.

8. Packing.

(a) Material shall be so prepared as to permit convenient handling and to prevent injury or damage during shipment.

9. Marking.

(a) Purchaser's order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of package.

(b) Detail list of loose pieces, shipments and their contents shall be furnished for each shipment. Where car-load shipments are made, routing and car identification shall be shown.

(c) Where car-load shipments are made, name and address of Consignee may be omitted.

10. Warranty.

(a) Contractor shall warrant the material covered by this specification to be free from defects in material and workmanship under ordinary use and service this obligation under this warranty being limited to making, at point of production, any part or parts to replace those which shall be found defective within one (1) year after shipment to the Purchaser. This warranty shall not apply to any apparatus which shall have been repaired or altered in any way by anyone other than the Manufacturer thereof, so as to, in the Contractor's judgment, affect its proper functioning or reliability nor which has been subject to misuse, negligence or accident.

SPECIFICATION FOR FRICTION TAPE.

1919.

(Official Approval May, 1920.)

1. *General.*

(a) Tape shall be made of cotton sheeting which is thoroughly impregnated on both sides with a friction rubber compound. The edges of the tape shall be straight and the width even. No pin holes should be observable when the tape is held before a strong light. 1914.

(b) Unless otherwise specified, the tape shall be three-fourths (¾) inch in width. 1919.

2. *Friction rubber compound.*

(a) The compound shall have a rubber base and be of the strength and insulating qualities required to meet the specified physical and electrical tests. 1914.

(b) The compound shall be free from active sulphur or other substances which will act injuriously on copper or the cotton tape. 1914.

3. *Cotton sheeting.*

(a) The cotton sheeting from which the tape is made shall be well, evenly and firmly woven from good cotton and free from defects, dirt, knots, lumps and objectionable irregularities of twist. The warp of the fabric shall extend lengthwise when unwound from the original roll. 1914.

4. *Tests.*

(a) Tests may be made at point of production, or on samples submitted, and may also be made at destination. (S. S. 7-a.) 1919.

(b) Contractor shall give the Purchaser sufficient notice of time when material will be ready for testing. (S. S. 7-b.) 1919.

(c) Contractor shall provide at point of production, apparatus and labor for making the required tests under supervision of the Purchaser. (S. S. 7-c.) 1919.

(d) Tests shall be made from samples taken from any part of any roll. 1919.

5. *Physical tests for tape three-fourths (3/4) inch width.*

(a) The finished tape shall be unwound from the original roll and at a temperature of seventy (70) degrees F. (21° C.) in an atmosphere maintained at approximately seventy (70) degrees F. (21° C.), wound in concentric layers for a distance of fourteen (14) inches at the rate of twelve (12) inches in two (2) minutes upon a one-fourth (¼) inch mandrel under a tension of seven and one-half

5-a. *Physical tests for tape three-fourths (3/4) inch width.*—Con.

(7½) pounds. The mandrel shall have ball bearings thirty-nine hundred thirty-seven ten-thousandths (.3937) inch diameter of bore and be adjusted to turn freely with a weight of twenty-two (22) grams suspended from a cotton string wound in a single layer on center of mandrel. 1919.

(b) After winding, the tape shall stand for three (3) minutes with the seven and one-half (7½) pound weight attached and shall then be unwound under a tension of three (3) pounds. 1919.

(c) The adhesion between the plies shall be such that the rate of unwinding after two (2) inches have been unwound shall not exceed eight (8) inches in three (3) minutes. 1919.

6. *Tensile strength for tape three-fourths (3/4) inch width.*

(a) The tensile strength of the tape shall be not less than thirty (30) pounds. 1919.

(b) The test for tensile strength shall be made on a piece of tape twelve (12) inches in length between grips and stretched at the rate of ten (10) inches per minute. 1919.

7. *Heat tests for tape three-fourths (3/4) inch width.*

(a) A strip of tape eighteen (18) inches in length, taken from the original roll, shall be exposed to a dry heat of approximately two hundred and ten (210) degrees F. (99° C.) for sixteen (16) hours. 1919.

(b) Upon removal from the heat, with the tape at a temperature of seventy (70) degrees F. (21° C.) and in an atmosphere maintained at approximately seventy (70) degrees F. (21° C.), it shall be wound in concentric layers for a distance of fourteen (14) inches upon the one-fourth (¼) inch mandrel at a rate of twelve (12) inches in two (2) minutes under a tension of seven and one-half (7½) pounds. 1919.

(c) After winding, the tape shall stand for three (3) minutes with the seven and one-half (7½) pound weight attached and shall then be unwound under a tension of one and one-half (1½) pounds. 1919.

(d) The adhesion between the plies shall be such that the rate of unwinding after two (2) inches have been unwound shall not exceed eight (8) inches in three (3) minutes. 1919.

8. *Electrical test.*

(a) The tape shall stand a potential strain of one thousand (1000) volts (effective value) sixty (60) cycles applied for one (1) minute by passing a section of tape between two brass ball electrodes, each three-fourths (¾) inch diameter. The electrodes shall be spaced so that tape will just move between them. 1919.

(b) The voltage shall be gradually increased, after tape has been placed between electrodes, until limiting value is attained. 1919.

9. *Inspection.*

(a) Purchaser may inspect the material at all stages of manufacture. (S. S. 6-a.) 1919.

(b) Purchaser may inspect the completed product to determine that the requirements of this specification have been met. (S. S. 6-b.) 1919.

(c) If the material has not been accepted at point of production, and if, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected, and the Contractor, upon request, shall advise the Purchaser what disposition is to be made of the defective material. The Contractor shall pay all freight charges. (S. S. 6-c.) 1919.

(d) If Purchaser is to make inspection at point of production, it shall be so stated. (S. S. 6-d.) 1917.

10. *Packing.*

(a) Material shall be so prepared as to permit convenient handling and to protect against loss or damage during shipment. (S. S. 8-a.) 1919.

(b) The tape shall be furnished in rolled strips having the following dimensions and weight:

Width Inches	Approximate thickness	Minimum Length per pound	Weight per roll, pounds
½	.015	135 ft.	0.33
¾	.015	90 ft.	0.5
1	.015	67.5 ft.	0.67
1½	.015	45 ft.	1.0
2	.015	33 ft.	1.34

1919.

(c) Each roll shall be enclosed in a tin box or wrapped in tin-foil and enclosed in a box to secure and fully protect the contents. 1914.

(d) Each package shall contain the full specified weight of tape, exclusive of wrapping and boxes, and shall be marked with the Manufacturer's name, width of tape and its weight. 1914.

11. *Marking.*

(a) Purchaser's order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of package.
(S. S. 9-a.) 1919.

(x) Remarks ..... 1916.

(y) Signed ..... 1916.

(z) Date ..... 1916.

SPECIFICATION FOR SINGLE-PHASE, AIR-COOLED TRACK TRANSFORMER.

1919.

(Official Approval May, 1920.)

1. *Requisite sheet.*

(a) Requisite sheet, section 18, attached to this specification, shall form a part thereof. (S. S. 4-a.) 1919.

(b) Where blanks have not been filled, or where an option is permitted and no preference stated, the Contractor's recommended practice shall be followed. (S. S. 4-b.) 1919.

2. *Tender.*

(a) The tender shall be for apparatus meeting the requirements of this specification. If the Contractor wishes to vary from the specification, a tender may be submitted covering the apparatus he desires to furnish. This tender shall be accompanied by full information showing wherein the requirements of this specification are varied from. (S. S. 3-a.) 1919.

3. *Type.*

(a) Transformers may be of the core or shell type. 1918.

(b) Transformers shall be air-cooled and designed for either indoor or outdoor service as specified on requisite sheet. 1918.

(c) Transformers shall be designed for either wall or shelf mounting. 1918.

4. *Frequency.*

(a) Transformers shall be designed for frequency specified on requisite sheet. 1918.

5. *Rating.*

(a) Transformers shall have a continuous k.v.a. rating equal to the sum of the ratings of all of the secondaries, as specified on requisite sheet. 1918.

6. *Windings.*

(a) The voltage, k.v.a. capacity, power factor and other data regarding the load on the separate windings, shall be as specified on requisite sheet. 1918.

(b) Voltages specified on requisite sheet shall be based on full load operation at the power factor specified. 1918.

7. *Voltage diagram.*

(a) Diagram showing the total full load voltage, tap voltages, and k.v.a. capacity of each winding and the relative or instantaneous polarities of the leads shall be securely attached to each transformer. 1919.

SPECIFICATION FOR SINGLE-PHASE, AIR-COOLED TRACK TRANSFORMERS.

1919.

(Official, Approved May, 1920.)

1. Requisite sheet.

(a) Requisite sheet, section 16, attached to this specification, shall form a part thereof. (S. S. 4-20) 1919

(b) Where circuits have not been fixed, or where an option is permitted and no preference stated, the Committee's recommended practice shall be followed. (S. S. 4-20) 1919

2. Tender.

(a) The tender shall be for apparatus meeting the requirements of this specification. If the Contractor wishes to vary from the specification, a tender may be submitted covering the apparatus he desires to furnish. This tender shall be accompanied by full information showing wherein the requirements of this specification are varied from.

3. Type.

(a) Transformers may be of the core or shell type. 1919.

(b) Transformers shall be air-cooled and designed for either indoor or outdoor service as specified on requisite sheet.

(c) Transformers shall be designed for either non-inductive mounting. 1919

4. Frequency.

(a) Transformers shall be designed for frequency specified on requisite sheet. 1919.

5. Rating.

(a) Transformers shall have a continuous A.C. rating equal to the sum of the current in all of the secondaries as specified on requisite sheet. 1919.

6. Windings.

(a) The voltage, kva. capacity, power factor and other data regarding the load on the separate windings shall be as specified on requisite sheet. 1919.

(b) Voltages specified on requisite sheet shall be based on full load operation at the power factor specified. 1919

7. Voltage diagram.

(a) Diagram showing the total full load voltage, tap voltages, and kva. capacity of each winding and the relative or instantaneous polarities of the leads shall be securely attached to each transformer. 1919.

8. *Leads and terminal boards.*

(a) Terminal boards shall be made of treated hard wood not less than one-half (½) inch thick or as specified on requisite sheet. 1918.

(b) Terminal boards shall be located so as to be easily accessible. 1918.

(c) Leads from windings shall be brought to and uniformly arranged on a terminal board. 1918.

(d) Where the winding conductor is of smaller cross section than No. 14 A. W. G. a flexible or strip conductor of not less than No. 16 A. W. G. conductivity shall be used from winding to the terminal post. 1919.

(e) Binding posts on the terminal board shall conform to R. S. A. 1070. They shall be so arranged that they will be separated by not less than three-eighths (⅜) inch air space. 1918.

(f) The instantaneous external polarities of windings shall be indicated by plainly marking the relative positive and negative leads from each winding. They shall be determined as follows:

1. The positive terminal of the primary winding shall be arbitrarily indicated. 1917.

2. The positive terminal of a secondary winding will then be that terminal from which current is flowing out to the load at the instant when current is flowing into the positive terminal of the primary winding. 1917.

(g) All transformers of a given type and manufacture shall be arranged so that the instantaneous polarities of corresponding leads are as shown on requisite sheet. 1917.

9. *Core.*

(a) The core shall be of non-aging laminated sheet steel so assembled that no buzzing is perceptible. 1919.

(b) The steel shall be considered non-aging provided aging co-efficient does not exceed one and three-hundredths (1.03) after subjecting the steel to a continuous temperature of one hundred (100) degrees C. (212° F.) for a period of thirty (30) days. 1919.

10. *Insulation.*

(a) Coils and windings shall be of cotton or silk-covered wire impregnated; of enameled wire, or as shown on requisite sheet. Enameling or impregnation shall be in accordance with R. S. A. specifications.

(G. E. R. 32-a.) 1919.

8. Leads and terminal board.

(a) Terminal boards shall be made of treated hard wood not less than one-half (½) inch thick or as specified on requisite sheet.

(b) Terminal boards shall be located so as to be easily accessible.

(c) Leads from cabinets shall be brought to and uniformly arranged on a terminal board.

(d) Wires, the standing conductor is of smaller cross section than No. 14 A. W. G., a flexible or litz conductor of not less than No. 16 A. W. G. conductivity shall be used from winding to the terminal post.

(e) Binding posts or the terminal board shall conform to E. E. A. type. They shall be so arranged that they will be separated by not less than three-eighths (⅜) inch air space.

(f) The terminals of secondary windings shall be indicated by plainly marking the positive polarity and negative leads from each winding. They shall be determined as follows:

a. The positive terminal of the primary winding shall be arbitrarily indicated.

b. The positive terminal of a secondary winding will then be that terminal from which current is flowing out to the load as the primary winding is flowing into the positive terminal of the primary winding.

(g) All transformers of a given type and manufacture shall be arranged so that the instantaneous polarity of corresponding leads are as shown on requisite sheet.

9. Core.

(a) The core shall be of non-aging laminated sheet steel so laminated that no eddying is perceptible.

(b) The steel shall be considered non-aging provided aging co-efficient does not exceed one and three-hundredths (1.03) after subjecting the steel to a continuous temperature of one hundred (100) degrees C. (212° F.) for a period of thirty (30) days.

10. Insulation.

(a) Coils and windings shall be of cotton or silk covered wire impregnated or somewhat wire, or as shown on requisite sheet. Insulating or impregnating shall be in accordance with E. E. A. specifications.

10. *Insulation.*—Continued.

(b) Material used for insulation shall be such as will not be injuriously affected by atmospheric conditions.
(G. E. R. 32-b.) 1917.

11. *Dielectric requirements.*

(a) Unless otherwise specified, electric apparatus assembled shall withstand for one (1) minute an insulation test at place of manufacture of three thousand (3000) volts a.c. between all parts of electric circuits and other metallic parts insulated therefrom.
(G. E. R. 30-a.) 1919.

(b) A surface leakage distance of not less than three-eighths (3/8) inch shall be provided between any exposed metallic part of the apparatus carrying current and any other metallic part thereof. (G. E. R. 30-b.) 1919.

(d) A potential of twice the normal operating requirements at a suitable frequency shall be impressed across the windings without any excessive flow of current indicating a short circuit. (G. E R. 30-d.) 1919.

12. *Tests.*

(c) Contractor shall provide, at point of production, apparatus and labor for making the required tests under supervision of the Purchaser. (S. S. 7-c.) 1919.

(d) Tests shall be made as specified on requisite sheet. 1917.

(e) Tests enumerated below shall be made on all the transformers.

1. Exciting current. 1918.
2. No load voltage ratio. 1918.
3. Polarity. 1918.
4. Short circuit (high frequency test). 1918.
5. Dielectric strength. 1918.

(f) The following tests shall be made on the first two transformers of new characteristics. 1919.

1. Core loss. 1918.
2. Copper loss. 1918.
3. Regulation. 1918.
4. Temperature rise. 1918.
5. Full load voltage ratio. 1918.

13. *Description of tests.*

(a) Core loss.

Core loss and exciting current shall be taken at any convenient ambient temperature, preferably not less than fifteen (15) degrees C. (59° F.). The core loss shall be measured with the watt meter at normal frequency and voltage using power from a generator giving sine wave, when such is available. When a pure sine wave is not avail-

10. Insulation.—Continued.

(b) Material used for insulation shall be such as will not be injuriously affected by atmospheric conditions.
(G. E. R. 31-b.) 1917.

11. Dielectric requirements.

(a) Unless otherwise specified, electric apparatus assembled shall withstand for one (1) minute an insulation test at place of manufacture of three thousand (3000) volts a.c. between all parts of electric circuits and other metallic parts insulated therefrom.
(G. E. R. 30-a.) 1919.

(b) A surface leakage distance of not less than three-eighths (3/8) inch shall be provided between any exposed metallic part of the apparatus carrying current and any other metallic part thereof. (G. E. R. 30-b.) 1919

(d) A potential of twice the normal operating requirements at a suitable frequency shall be impressed across the windings without any excessive flow of current indicating a short circuit. (G. E. R. 30-d.) 1919.

12. Tests.

(c) Contractor shall provide at point of production, apparatus and labor for making the required tests under supervision of the Purchaser. (S. S. p-c.) 1914.

(d) Tests shall be made as specified on requisite sheet.
1917.

(e) Tests enumerated below shall be made on all the transformers.

a. Exciting current. 1918.
b. No load voltage ratio. 1918.
c. Polarity. 1918
d. Short circuit (high frequency test). 1918
e. Dielectric strength. 1918.

(f) The following tests shall be made on the first two transformers of new characteristics. 1918

a. Core loss. 1918
b. Copper loss. 1918
c. Regulation. 1918.
d. Temperature rise. 1918.
e. Full load voltage ratio. 1918.

13. Description of tests.

(a) Core loss

Core loss and exciting current shall be taken at any convenient ambient temperature, preferably not less than fifteen (15) degrees C. (59° F.). The core loss shall be measured with the watt meter at normal frequency and voltage using power from a generator giving sine wave when such is available. When a pure sine wave is not avail-

13. *Description of tests.*—Continued.

able, it shall be permissible to use any wave form which comes within the A. I. E. E. definition of a sine wave, adjusting the test voltage so that the core loss will be the same as with the normal voltage and sine wave. Where voltage cannot be regulated by excitation of the generator, it must be done with auto transformer and not by rheostat in series with the transformer to be tested. The average of the core losses of the two transformers of the same size on one order shall not exceed the value specified on requisite sheet and the maximum core loss must in no case exceed this value by more than ten (10) per cent. 1919.

(b) Exciting current.

The average exciting current shall not exceed twenty (20) per cent. of full load current. 1918.

(c) Copper loss.

Copper loss shall be determined by watt meter in accordance with A. I. E. E. standard for load loss. 1919.

(d) Full load voltage ratio.

The voltage ratio of the transformer shall be checked by impressing the rated voltage and frequency on the primary winding and reading all secondary voltages with rated current flowing in each terminal at the power factor specified on requisite sheet. The value obtained shall not vary more than two (2) per cent. plus or minus from the values given on the voltage diagram and requisite sheet. 1918.

(e) Polarity.

Polarity of all transformers shall be checked as follows:

Connect the relatively positive terminal of one winding to the relatively negative terminal of another winding, until all the windings are in series, impressing rated voltage across the terminals of the primary windings. The voltmeter connected between the two ends of all the windings in the series shall read the sum of all their voltages. 1917.

(f) Regulation.

1. With no load the voltage of each of the windings shall not exceed the full load value specified on requisite sheet by more than ten (10) per cent. 1918.

2. When calculated, the regulation for either the whole or part of the transformer shall be computed from the measured resistance and the reactance drop

13. Description of tests—Continued.

sole, it shall be permissible to use any wave form which comes within the A. I. E. E. definition of a sine wave, adjusting the test voltage so that the core loss will be the same as with the normal voltage and sine wave. Where voltage cannot be regulated by excitation of the generator, it must be done with auto transformer and not by rheostat in series with the transformer to be tested. The average of the core losses of the two transformers of the same size on one order shall not exceed the value specified on requisite sheet and the maximum core loss must in no case exceed this value by more than ten (10) per cent.

(b) Exciting current.

The average exciting current shall not exceed twenty (20) per cent of full load current.

(c) Copper loss.

Copper loss shall be determined by watt meter in accordance with A. I. E. E. standard for load loss.

(d) Full load voltage ratio.

The voltage ratio of the transformer shall be checked by impressing the rated voltage and frequency on the primary winding and reading all secondary voltages with rated current flowing in each terminal at the power factor specified on requisite sheet. The value obtained shall not vary more than two (2) per cent. plus or minus from the values given on the voltage diagram and requisite sheet.

(e) Polarity.

Polarity of all transformers shall be checked as follows:

Connect the relatively positive terminal of one winding to the relatively negative terminal of another winding, until all the windings are in series, impressing rated voltage across the terminals of the primary windings. The voltmeter connected between the two ends of all the windings in the series shall read the sum of all their voltages.

(f) Regulation.

1. With no load the voltage of each of the windings shall not exceed the full load value specified on requisite sheet by more than ten (10) per cent.

2. When calculated, the regulation for either the whole or part of the transformer shall be computed from the measured resistance and the reactance drop

12-(f)-2. *Description of tests.*—Continued.

of voltage using the method as given in the A. I. E. E. standardization rules. 1918.

(g) Temperature rise.

1. The first two (2) transformers of each size shall be selected for heating test of that type. 1918.

2. When tested for temperature rise, transformers may be overloaded and overexcited to hasten the rise of temperature to the ultimate value under normal load and final temperature in any part maintained for one (1) hour under constant full load and normal voltage and frequency shall not exceed the temperature of the room more than fifty-five (55) degrees C. (131° F.). The rise of temperature shall be determined by the increase of resistance of the windings and by thermometer placed as directed by representative of the Purchaser and the highest indicated temperature shall be taken to determine the rise. 1919.

14. *Inspection.*

(a) Purchaser may inspect the material at all stages of manufacture. (S. S. 6-a.) 1919.

(b) Purchaser may inspect the completed product to determine that the requirements of this specification have been met. (S. S. 6-b.) 1919.

(c) If the material has not been accepted at point of production, and if, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected and the Contractor, upon request, shall advise the Purchaser what disposition is to be made of the defective material. The Contractor shall pay all freight charges. (S. S. 6-c.) 1919.

(d) If Purchaser is to make inspection at point of production, it shall be so stated. (S. S. 6-d.) 1919.

15. *Warranty.*

(a) Contractor shall warrant the material covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to making, at point of production, any part or parts to replace those which shall be found defective within one (1) year after shipment to the Purchaser. This warranty shall not apply to any apparatus which shall have been repaired or altered in any way by anyone other than the Manufacturer thereof so as to, in the Contractor's judgment, affect its proper functioning or reliability, nor which has been subject to misuse, negligence or accident. (S. S. 10-a.) 1919.

12-(j)-a. Description of tests.—Continued.
of voltage using the method as given in the A. I. E. E. standardization rules. 1918.
(g) Temperature rise
1. The first two (a) transformers of each size shall be selected for heating test of that type. 1918.
2. When tested for temperature rise, transformers may be overloaded and overexcited to hasten the rise of temperature to the ultimate value under normal load and final temperature in any part maintained for one (1) hour under constant full load and normal voltage and frequency shall not exceed the temperature of the room more than fifty-five (55) degrees C. (131 F.). The rise of temperature shall be determined by the increase of resistance of the windings and by thermometer placed as directed by representative of the Purchaser and the highest indicated temperature shall be taken to determine the rise. 1918.

14. Inspection.
(a) Purchaser may inspect the material at all stages of manufacture. (S. S. 6-a.) 1918.
(b) Purchaser may inspect the completed product to determine that the requirements of this specification have been met. (S. S. 6-b.) 1918.
(c) If the material has not been accepted at point of production, and if, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected and the Contractor, upon request, shall advise the Purchaser what disposition is to be made of the defective material. The Contractor shall pay all freight charges. (S. S. 6-c.) 1918.
(d) If Purchaser is to make inspection at point of production, it shall be so stated. (S. S. 6-d.) 1918

15. Warranty.
(a) Contractor shall warrant the material covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to making, at point of production, any part or parts to replace those which shall be found defective within one (1) year after shipment to the Purchaser. This warranty shall not apply to any apparatus which shall have been repaired or altered in any way by anyone other than the Manufacturer thereof so as to, in the Contractor's judgment, affect its proper functioning of reliability, nor which has been subject to misuse, negligence or accident. (S. S. 10-a.) 1918.

16. *Packing.*

(a) Material shall be so prepared as to permit convenient handling and to protect against loss or damage during shipment. (S. S. 8-a.) 1919.

17. *Marking.*

(a) Purchaser's order, requisition and package number, name of Consignor and name and address of Consignee, shall be plainly marked on outside of package. (S. S. 9-a.) 1919.

(b) Detailed list of loose pieces, containers and their contents shall be furnished for each shipment. Where car-load shipments are made, routing and car identification shall be shown. (S. S. 9-b.) 1919.

(c) Where car-load shipments are made, name and address of Consignee may be omitted. (S. S. 9-c.) 1919.

18. *Requisites for single-phase, air-cooled track transformer, A.R.A. specification.*

(a) Purchaser to fill in such items as he desires to specify. Contractor to fill in all other blanks, so that the requisite sheet will be complete when finally submitted with Contractor's quotation. 1918.

(b) Identification.

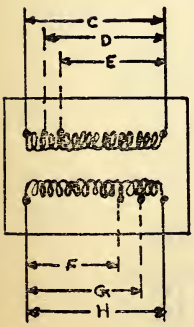
Transformers covered by this sheet are for .... Railroad on Inquiry ....., Order ....., Requisition ....., and are to be of { outdoor / indoor } type. 1919.

(c) Quantity required ..... 1917.

(d) Frequency ..... cycles. 1917.
Core loss ..... watts. 1917.
Copper loss ..... watts. 1917.
Exciting current ..... per cent. 1917.

(e) Coils and windings shall be of ..... covered copper wire. 1919.

(f)



VOLTAGE, CAPACITY, POWER FACTOR AND REGULATION TABLE

WINDING	VOLTS FULL LOAD	MAX. K.V.A.	RATED K.V.A.	P.F. PER CENT	PER CENT REGULATION 100% P.F.	PER CENT REGULATION 80% P.F.
C	1					
D						
E						
F						
G						
H						

Typical diagram, show polarity. 1919.

16. Packing.

(a) Material shall be so prepared as to permit convenient handling and to protect against loss or damage during shipment. (S. S. 3-a.) 1920

17. Marking.

(a) Purchaser's order, requisition and package number, name of Consignor and name and address of Consignee, shall be plainly marked on outside of package. (S. S. 3-a.) 1919.

(b) Detailed list of loose pieces, containers and their contents shall be furnished for each shipment. Where car-load shipment are made routing and car identification shall be shown. (S. S. 3-b.) 1919.

(c) Where car-load shipments are made, name and address of Consignee may be omitted. (S. S. 3-c.) 1919.

18. Requisites for single phase, air-cooled track transformer, A.R.A. specification.

(a) Purchaser to fill in such items as the device to specify. Contractor to fill in all other blanks, so that the requisite sheet will be complete when duly submitted with Contractor's quotation. 1919.

(b) Identification.

Transformers covered by this sheet are to ..... Railroad on Inquiry ..... Order Requisition ..... and are to be of

{ outdoor } type
{ indoor }

(c) Quantity required 1919

(d) Frequency ..... cycles 1919

Core ..... watts 1919

Copper ..... watts 1919

Exciting current ..... per cent. 1919

(e) Coils and windings shall be of ..... covered copper wire 1919.

(f)

Typical diagram, 1919.
show polarity.

VOLTAGE, CAPACITY, POWER FACTOR AND REGULATION TABLE

Number	Watts Output	Watts Input	Ratio Eff. %	E. M. F.	Per cent Regulation
5					
6					
7					
8					
9					
10					

18. *Requisites for single-phase, air-cooled track transformer, A. R. A. specification.*—Continued.

(g) Terminal boards shall be ..... 1918.

(h) Track circuit data.

1. Length of track circuit .....
2. Size of rail ..... pounds per yard.
3. Kind of bond wire .....
4. Size of bond wire ..... A.W.G. or C.M.
5. Kind of bonding pin .....
6. Kind of ballast .....
7. Resistance in ohms between rails per thousand feet of track .....
8. Resistance of rail in ohms per thousand feet of track .....
9. Kind of traction power .....
10. Impedance bond required .....
11. Electric traction:
    (a) Alternating current .....
    (b) Direct current .....
12. A.C. electric traction frequency .....
13. Number of amperes propulsion current per rail .....
14. Power returned:
    (a) Double rail .....
    (b) Single rail .....
15. Inductive bond impedance ..... ohms at ..... volts. 1918.

(i) Weight.

1. Total net weight .....
2. Total shipping weight ..... 1919.

(j) Inspection or tests.

1. Shall inspection or tests be made at point of production under supervision of Purchaser? ..... 1917.
2. ..... days' notice required by Purchaser before apparatus will be ready for inspection or test. 1916.
3. Shall inspection or tests be made at destination by Purchaser? ..... 1918.
4. Shall record of inspection and tests as furnished Contractor be accepted? ..... 1919.

(x) Remarks .....
..... 1916.

(y) Signed ..... 1916.

(z) Date ..... 1916.

18. Requisites for single-phase, ac-coded track transference, A. R. A. specification—Continued.

(g) Terminal boards shall be . . . . . page.

(h) Track circuit data:

1. Length of track circuit . . . . . .
2. Size of rail . . . . . pounds per yard.
3. Kind of bond wire . . . . . .
4. Size of bond wire . . . . . A.W.G. or C.M.
5. Kind of bonding gun . . . . . .
6. Kind of ballast . . . . . .
7. Resistance to ohms between rails per thousand feet and feet of track . . . . . .
8. Resistance of rail in ohms per thousand feet of track . . . . . .
9. Kind of traction power . . . . . .
10. Impedance bond required . . . . . .
11. Electric traction:
(a) Alternating current . . . . . .
(b) Direct current . . . . . .
12. A.C. electric traction frequency . . . . .
13. Number of amperes propulsion current per rail . . . . . .
14. Power returned:
(a) Double rail . . . . . .
(b) Single rail . . . . . .
15. Inductive bond impedance . . . . . ohms at . . . . . volts . . . . . page.

(i) Weight.

1. Total net weight . . . . . .
2. Total shipping weight . . . . . page.

(j) Inspection of tests.

1. Shall inspection or tests be made at point of production under supervision of Purchaser . . . . . page.
2. . . . . days' notice required by Purchaser before apparatus will be ready for inspection or test . . . . . page.
3. Shall inspection or tests be made at destination by Purchaser . . . . . page.
4. Shall record of inspection and tests as furnished Contractor be accepted? . . . . . page.

(k) Remarks . . . . . page.

(l) Signed . . . . . page.

(m) Date . . . . . page.

American Railroad Association.
Signal Division.

SPECIFICATION FOR SINGLE-PHASE LINE TRANSFORMER, OIL IMMERSED, SELF-COOLED.

1919.

(Official Approval May, 1920.)

1. *Requisite sheet.*

(a) Requisite sheet, section 21, attached to this specification, shall form a part thereof. (S. S. 4-a.) 1919.

(b) Where blanks have not been filled, or where an option is permitted and no preference stated, the Contractor's recommended practice shall be followed. (S. S. 4-b.) 1919.

2. *Tender.*

(a) The tender shall be for apparatus meeting the requirements of this specification. If the Contractor wishes to vary from the specification a tender may be submitted covering the apparatus he desires to furnish. This tender shall be accompanied by full information showing wherein the requirements of the specification are varied from. (S. S. 3-a.) 1919.

3. *Type.*

(a) Transformers may be of the core or shell type. 1919.

(b) Transformers shall be oil immersed, self-cooling, and designed for service as specified on requisite sheet. 1919.

4. *Frequency.*

(a) Transformer shall be designed for frequency specified on requisite sheet. 1919.

5. *Rating.*

(a) Transformer shall have a continuous k.v.a. rating equal to the sum of the ratings of all secondaries, as specified on requisite sheet. 1919.

6. *Windings.*

(a) The voltages, k.v.a. capacities, power factors and other data regarding the load on the separate windings shall be as specified on requisite sheet. 1919.

(b) Voltages specified on requisite sheet shall be based on no load operation and are subject to the effects of regulation at various loads and power factors. 1919.

7. *Case.*

(a) Transformer case shall be made of material as specified on requisite sheet and provided with cast iron cover. Eye-bolts or lugs shall be provided for handling the transformer and lugs for supporting it. Case shall be

SPECIFICATION FOR SINGLE-PHASE LINE TRANSFORMER, OIL IMMERSED, SELF-COOLED

1919.

(Official Approval May, 1920.)

1. Requisite sheet.

(a) Requisite sheet, section 21, attached to this specification, shall form a part thereof. (S. 2, 4-a.) 1919.

(b) Where blanks have not been filled, or where in opinion is permitted and no preference stated, the Contractor's recommended practice shall be followed.

(S. 3, 4-b.) 1919.

2. Tender.

(a) The tender shall be for apparatus meeting the requirements of this specification. If the Contractor wishes to vary from the specification a tender may be submitted covering the apparatus he desires to furnish. This tender shall be accompanied by full information showing wherein the requirement of the specification are varied from.

(S. 3, 4-a.) 1919.

3. Type.

(a) Transformers may be of the core or shell type.

1919.

(b) Transformers shall be oil immersed, self-cooling, and designed for service as specified on requisite sheet.

1919.

4. Frequency.

(a) Transformer shall be designed for frequency specified on requisite sheet.

1919.

5. Rating.

(a) Transformer shall have a continuous K.v.a. rating equal to the sum of the ratings of all secondaries, as specified on requisite sheet.

1919.

6. Windings.

(a) The voltages, k.v.a. capacities, power factors and other data regarding the load on the secondary windings shall be as specified on requisite sheet.

1919.

(b) Voltages specified on requisite sheet shall be based on no load operation and are subject to the effects of regulation at various loads and lower factors 1919.

7. Case.

(a) Transformer case shall be made of material as specified on requisite sheet and provided with cast iron cover. Eye-bolts or lugs shall be provided for handling the transformer and lugs for supporting it. Case shall be

7-a. *Case.*—Continued.

free from leaks and shall be impervious to oil. Covers shall be provided with felt or other suitable gaskets. Plugs shall be provided at bottom of case for removing fluids. When specified on requisite sheet, the case shall be provided with a suitable terminal for grounding. 1919.

8. *Voltage diagram.*

(a) A diagram showing the total no load voltage, tap voltages and k.v.a. capacity of each winding and the relative or instantaneous polarities of the leads shall be furnished with each transformer. Diagram shall be securely attached to each transformer. 1919.

9. *Material and workmanship.*

(a) Material and workmanship shall be first-class in every respect. (S. S. 5-a.) 1911.

10. *Hangers.*

(a) Hanger irons and bolts, of sufficient strength to support transformer in an upright position on pole, shall be furnished unless otherwise specified on requisite sheet. 1919.

11. *Leads and terminal boards.*

(a) Leads out of case shall be of insulated flexible wire of a cross section not less than number twelve (12) A. W. G. 1916.

(b) Leads shall be brought out of the case through suitable bushings which shall be sealed into the case with an oil-proof compound, containing not more than one (1) per cent. of sulphur, and which will not soften sufficiently to flow at any temperature less than one hundred (100) degrees C. (212° F.). The leads shall be brought through the bushings in such a manner that syphoning of oil by capillary attraction is prevented. 1919.

(c) Tap leads from high voltage windings shall be brought to a terminal board or boards mounted inside of case in a readily accessible position, but submerged in oil. 1916.

(d) Where winding conductor is of smaller cross section than number sixteen (16) A. W. G., a flexible conductor of not less than number sixteen (16) A. W. G. shall be used as a lead from the winding to the terminal board. Where number sixteen (16) A. W. G. conductor is used as a lead it shall be enclosed in a fibre tube or otherwise suitably supported. 1917.

7-a. Case.—Continued.

free from leaks and shall be impervious to oil. Covers shall be provided with felt or other suitable gaskets. Plugs shall be provided at bottom of case for removing fluids. When specified on requisite sheet, the case shall be provided with a suitable terminal for grounding.

8. Voltage diagram.

(a) A diagram showing the total no load voltage, tap voltages and k.v.a. capacity of each winding and the relative or instantaneous polarities of the leads shall be furnished with each transformer. Diagram shall be accurately attached to each transformer.

9. Material and workmanship.

(a) Material and workmanship shall be first-class in every respect.

10. Flanges.

(a) Flanges irons and bolts, of sufficient strength to support transformer in an upright position on pole, shall be furnished unless otherwise specified on requisite sheet.

11. Leads and terminal boards.

(a) Leads out of case shall be of insulated flexible wire of a cross section not less than number twelve (12) A. W. G.

(b) Leads shall be brought out of the case through suitable bushings which shall be sealed into the case with an oil-proof compound, containing not more than one (1) per cent. of sulphur, and which will not soften sufficiently to flow at any temperature less than one hundred (100) degrees C. (212° F.). The leads shall be brought through the bushings in such a manner that siphoning of oil by capillary attraction is prevented.

(c) Tap leads from high voltage windings shall be brought to a terminal board on boards mounted inside of case in a readily accessible position, but submerged in oil.

(d) Where winding conductor is of smaller cross section than number sixteen (16) A. W. G., a flexible conductor of not less than number sixteen (16) A. W. G. shall be used as a lead from the winding to the terminal board. Where number sixteen (16) A. W. G. conductor is used as a lead it shall be enclosed in a fibre tube or otherwise suitably supported.

11. *Leads and terminal boards.*—Continued.

(e) The instantaneous external polarities of windings shall be indicated by plainly marking the relative positive and negative leads from each winding. They shall be determined as follows:

1. The positive terminal of the primary winding shall be arbitrarily indicated.

2. The positive terminal of a secondary winding will then be that terminal from which current is flowing out to the load at the instant when current is flowing into the positive terminal of the primary winding. 1917.

(f) All transformers of a given type and manufacture shall be arranged so that the instantaneous polarities of corresponding leads are as shown on requisite sheet. 1919.

12. *Core.*

(a) The core shall be of non-aging laminated sheet steel so assembled that no buzzing is perceptible. 1919.

(b) The steel shall be considered non-aging provided the aging coefficient does not exceed 1.02 after subjecting the steel to a continuous temperature of one hundred (100) degrees C. (212° F.) for a period of thirty (30) days. 1919.

13. *Oil.*

(a) Oil shall be as specified on requisite sheet. 1919.

(b) Sufficient oil shall be furnished to completely immerse the core, windings, high voltage terminal boards and terminals, and to adequately dissipate the heat generated by the losses. 1917.

14. *Insulation.*

(a) Coils and windings shall be of cotton or silk-covered wire impregnated; of enameled wire, or as shown on requisite sheet. Enameling or impregnation shall be in accordance with R. S. A. specifications. (G. E. R. 32-a.) 1919.

(b) The high voltage windings shall be insulated from the low voltage windings by a barrier of ample dielectric strength. Each turn shall be thoroughly insulated and the voltage between adjacent turns kept as low as is consistent with good design. Windings shall be carefully taped and leads shall be brought out in a thoroughly workmanlike manner. Unless enameled wire is used, windings shall be dried by the vacuum process and impregnated with an insulating compound. The windings

11. Leads and terminal boards.—Continued.

(c) The instantaneous external polarities of windings shall be indicated by plainly marking the relative positive and negative leads from each winding. They shall be determined as follows:

1. The positive terminal of the primary winding shall be arbitrarily indicated.

2. The positive terminal of a secondary winding will then be that terminal from which current is flowing out to the load at the instant when current is flowing into the positive terminal of the primary winding.

(d) All telephones of a given type and manufacture shall be arranged so that the instantaneous polarities of corresponding leads are as shown on required sheet.

12. Core.

(a) The core shall be of non-aging laminated sheet steel so assembled that no buzzing is perceptible.

(b) The steel shall be considered non-aging provided the aging coefficient does not exceed 1.05 after subjecting the steel to a continuous temperature of one hundred (100) degrees C. (212° F.) for a period of thirty (30) days.

13. Oil.

(a) Oil shall be as specified on requisite sheet.

(b) Sufficient oil shall be furnished to completely immerse the core, windings, main voltage terminal boards and terminals, and to adequately dissipate the heat generated by the losses.

14. Insulation.

(a) Coils and windings shall be of cotton or silk-covered wire unless otherwise specified on requisite sheet. Enameling or impregnation shall be in accordance with R. S. A. specifications.

(b) The high voltage windings shall be insulated from the low voltage windings by a barrier of ample dielectric strength. Each turn shall be thoroughly insulated and the voltage between adjacent turns kept as low as is consistent with good design. Windings shall be carefully taped and leads shall be brought out in a thoroughly workmanlike manner. Under-insulated wire is used, windings shall be dried by the vacuum process and impregnated with an insulating compound. The windings

14-b. *Insulation.*—Continued.

shall be so disposed as to permit the free circulation of oil and the maintenance of a nearly uniform temperature throughout. 1919.

(c) Material used as insulation shall be such as will not be injuriously affected by atmospheric conditions. It shall be moisture-proof and not soluble in, nor acted upon by, the transformer oil at operating temperature. 1917.

15. *Tests.*

(b) Contractor shall give the Purchaser sufficient notice of time when material will be ready for testing. (S. S. 7-b.) 1919.

(c) Contractor shall provide, at point of production, apparatus and labor for making the required tests under supervision of the Purchaser. (S. S. 7-c.) 1919.

(d) Tests enumerated below shall be made on all transformers:

1. Exciting current.
2. No load voltage ratio.
3. Polarity.
4. Dielectric strength.
5. Core loss.
6. Copper loss. 1917.

(e) The following test shall be made on the first two (2) transformers of new characteristics:

1. Regulation.
2. Temperature rise. 1919.

16. *Description of tests.*

(a) Core loss.

1. Core loss and exciting current shall be taken at any convenient ambient temperature, preferably not less than fifteen (15) degrees C. (59° F.). Core loss shall be measured with a watt meter at normal frequency and voltage, using power from generator giving a sine wave when such is available. When a pure sine wave is not available, it shall be permissible to use any wave form which comes within the A. I. E. E. definition of a sine wave, adjusting the test voltage so that the core loss will be the same as with normal voltage and sine wave. Where voltage cannot be regulated by excitation of the generator, it must be done with auto-transformers and not by rheostats in series with the transformers to be tested.

16. *Description of tests.*—Continued.

The average of the core losses of the full number of transformers of the same size on one order shall not exceed the value specified on requisite sheet and the maximum core loss must in no case exceed this value by more than ten (10) per cent. 1919.

(b) Exciting current.

1. The average exciting current as observed during the test for core loss shall not exceed the value specified on requisite sheet. For transformers from one (1) to five (5) k.v.a. capacity, the exciting current shall not exceed fifteen (15) per cent. of the full load current. For transformers of over five (5) k.v.a. capacity, the exciting current shall not exceed ten (10) per cent. of the full load current. With an applied voltage of ten (10) per cent. above normal, the exciting current shall in no case be more than double the percentage given for normal voltage. 1919.

(c) Copper loss.

1. Copper loss shall be determined by watt meter in accordance with A. I. E. E. standard for load loss. 1919.

(d) No load voltage ratio.

1. The voltage ratio of the transformer shall be checked by impressing rated voltage and frequency on the primary winding and reading all secondary open circuit or no load voltages with a voltmeter. The value obtained shall not vary more than two (2) per cent. plus or minus from the values given on the voltage diagram and requisite sheet. 1917.

(e) Polarity.

1. Polarity of all transformers shall be checked as follows: Connect the relatively positive terminal of one winding to the relatively negative terminal of another winding until all the windings are in series. Impress rated voltage across the terminals of the primary winding. A voltmeter connected between the two ends of all the windings in series shall read the sum of all their voltages. 1917.

(f) Insulation.

1. The windings shall withstand the following test voltages for one (1) minute. The transformer being filled with oil at the time the tests are made:

16. Description of tests—Continued.

(b) Heating current.

(c) Copper loss.

(d) No load voltage ratio.

(e) Polarity.

(f) Insulation.

16-f-1. *Description of tests.*—Continued.

z

Winding	Rated voltage of winding	Test voltage to all other windings and from winding to core
High or low voltage	0-549	Twice rated voltage plus 1000 v.
Low voltage	550-5000	Twice rated voltage plus 1000 v.
High voltage	550-5000	10,000 volts.
High or low voltage	5001 and above	Twice rated voltage plus 1000 v.

1917.

2. In case of a one-to-one transformer, one (1) winding shall be considered as high voltage and shall be insulated in accordance with the test for a high voltage winding of the rated voltage specified therefor. 1917.

3. The windings shall withstand for one (1) minute an impressed voltage at a suitable frequency of two (2) times the rated no load voltage. 1917.

(g) Regulation.

1. With the maximum rated load at the power factor specified on all of the circuits, the regulation of each of the windings shall not exceed the value specified on requisite sheet. 1919.

2. When calculated, the regulation for either the whole or part of the transformer shall be computed from the measured resistance and the reactance drop of voltage using the method as given in the A. I. E. E. Standardization rules. 1917.

(h) Temperature rise.

1. The two (2) transformers of each size whose combined core and copper losses come nearest to values specified on requisite sheet shall be selected for heating test of that type and size. 1919.

2. When tested for temperature rise, transformers may be overloaded and over-excited to hasten the rise of temperature to the ultimate value under normal load and the final temperature in any part maintained for one (1) hour under constant full load and normal voltage and frequency shall not exceed the temperature of the room by more than fifty-five (55) degrees C. (131° F.). The rise of temperature shall be determined by the increase of resistance of the windings and by the thermometer in the oil, placed as

15-1-1. Description of tests.—Continued.

Winding	Rated voltage of winding	Test voltage to all other windings and iron winding to core
High or low voltage	0-549	Twice rated voltage plus 1000 v.
Low voltage	550-3300	Twice rated voltage plus 1000 v.
High voltage	550-3300	10000 volts.
High or low voltage	550 and above	Twice rated voltage plus 1000 v.

2. In case of a one-to-one transformer one (1) winding shall be considered as high voltage and shall be insulated in accordance with the test for a high voltage winding of the rated voltage specified therefor.

3. The windings shall withstand for one (1) minute an impressed voltage at a suitable frequency of five (5) times the rated no load voltage.

(c) Regulation.

1. When the maximum rated load at the power factor specified on all of the circuit, the regulation of each of the windings shall not exceed the value specified on requisite sheet.

2. When calculated, the regulation for either the whole or part of the transformer shall be computed from the measured resistance and the reactance drop at voltage using the method as given in the A. I. E. E. Standardization rules (1917).

(d) Temperature rise.

1. The two (2) transformers of each size whose combined core and copper losses come nearest to values specified on requisite sheet shall be selected for heating test of that type and size. (1919).

2. When tested for temperature rise, transformers may be overloaded and over-excited to hasten the rise of temperature to the ultimate value under normal load and the final temperature in any part maintained for one (1) hour under constant full load and normal voltage and frequency shall not exceed the temperature of the room by more than fifty-five (55) degrees C. (131° F.). The rise of temperature shall be determined by the increase of resistance of the windings and by the thermometer in the oil placed at

16-h-2. *Description of tests.*—Continued.

directed by the representative of the Purchaser, and the highest indicated temperature shall be taken to determine the rise. 1919.

17. *Inspection.*

(a) Purchaser may inspect the material at all stages of manufacture. (S. S. 6-a.) 1919.

(b) Purchaser may inspect the completed product to determine that the requirements of this specification have been met. (S. S. 6-b.) 1919.

(c) If the material has not been accepted at point of production, and if, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected, and the Contractor, upon request, shall advise the Purchaser what disposition is to be made of the defective material. The Contractor shall pay all freight charges. (S. S. 6-c.) 1919.

(d) If Purchaser is to make inspection at point of production, it shall be so stated. (S. S. 6-d.) 1919.

18. *Warranty.*

(a) Contractor shall warrant the material covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to making, at point of production, any part or parts to replace those which shall be found defective within one (1) year after shipment to the Purchaser. This warranty shall not apply to any apparatus which shall have been repaired or altered in any way by anyone other than the Manufacturer thereof, so as to, in the Contractor's judgment, affect its proper functioning or reliability, nor which has been subject to misuse, negligence or accident. (S. S. 10-a.) 1919.

19. *Packing.*

(a) Material shall be so prepared as to permit convenient handling and to protect against loss or damage during shipment. (S. S. 8-a.) 1919.

20. *Marking.*

(a) Purchaser's order, requisition and package number, name of Consignor and name and address of Consignee shall be plainly marked on outside of package. (S. S. 9-a.) 1919.

(b) Detail list of loose pieces, containers and their contents, shall be furnished for each shipment. Where car-load shipments are made, routing and car identification shall be shown. (S. S. 9-b.) 1919.

16-B-2. Description of Tests.—Continued.

directed by the representative of the Purchaser, and the highest indicated temperature shall be taken to determine the rise.

17. Inspection.

(a) Purchaser may inspect the material at all stages of manufacture.

(b) Purchaser may inspect the complete oil product to determine that the requirements of this specification have been met.

(c) If the material has not been inspected at point of production, and if, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected and the Contractor, upon request, shall advise the Purchaser what disposition is to be made of the defective material. The Contractor shall pay all freight charges.

(d) If Purchaser is to make inspection at point of production, it shall be so stated.

18. Warranty.

(a) Contractor shall warrant the material covered by this specification to be free from defects in material and workmanship under ordinary use and service. His obligation under this warranty shall be limited to making, at contractor's option, any part or parts to replace those which shall be found defective within one (1) year after same shall have been delivered to the Purchaser. This warranty shall not apply to any apparatus which shall have been repaired or altered in any way by anyone other than the Manufacturer thereof, so as to, in the Contractor's judgment, affect its proper functioning or reliability, nor which has been subjected to misuse, negligence or accident.

19. Packing.

(a) Material shall be so packed as to permit convenient handling and to protect against loss or damage during shipment.

20. Marking.

(a) Purchaser's order, requisition and package number, name of Consignee and name and address of Consignor shall be plainly marked on outside of package.

(b) Detail list of loose pieces, containers and their contents, shall be furnished for each shipment. Where car-load shipments are made, testing and lot identification shall be shown.

20. *Marking.*—Continued.

(c) Where car-load shipments are made, name and address of Consignee may be omitted. (S. S. 9-c.) 1919.

21. *Requisites for single-phase line transformer, oil immersed, self-cooled, A. R. A. specification.*

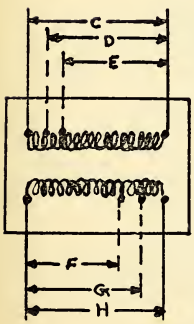
(a) Purchaser to fill in such items as he desires to specify. Contractor to fill in all other blanks, so that the requisite sheet will be complete when finally submitted with Contractor's quotation. 1919.

(b) Identification: Transformers covered by this sheet are for .....
..... Railroad on Inquiry ..... Order
..... Requisition ..... and are to be of
{ outdoor / manhole } type and be used for operation of .....
..... at ..... 1919.

(c) Quantity required ..... 1917.

(d) Frequency ..... cycles.
Core loss ..... watts.
Copper loss ..... watts.
Exciting current ..... per cent. 1919.

(e)



WINDING	VOLTS	MAX. K.V.A.	RATED K.V.A.	P. F. PER CENT	PER CENT REGULATION	
					100% P.F.	60% P.F.
C						
D						
E						
F						
G						
H						

1919.

Typical diagram,
show polarity.

(f) Coils and windings shall be of ..... covered copper wire. 1919.

(g) Transformer case shall be { cast iron. / sheet steel. / ..... } 1919.

(h) Transformers to be in accordance with A. R. A. specification. 1919.

(i) Weight.
1. Total net weight including oil .....
2. Total shipping weight .....
1919.

20. Marking.—Continued.

(c) Where car-load shipments are made, name and address of Consignee may be omitted. (S. S. 4-c.) 1919.

21. Requisites for single-phase line transformers, oil immersed, self-cooled, A. S. A. specification.

(a) Purchaser to fill in such items as be desired in specification. Contractor to fill in all other items so that the specification sheet will be complete when finally submitted with Contractor's quotation. 1919.

(b) Identification. Transformers covered by this sheet are the ..... Quantity ..... Order No. ..... Date ..... Required on Inquiry ..... Date ..... Requisition No. ..... Date ..... Number / Identification / Units are to be used for operation of ..... at ..... cycles. 1919.

(c) Quantity required ..... 1919.

(d) Frequency ..... cycles.

Core loss ..... watts.

Copper loss ..... watts.

Heating current ..... per cent. 1919.

(e)

Designation	Voltage	Kilovolt-amperes	Current	Connections	Taps, Plus and Minus Percentage
C					
D					
E					
F					
G					
H					

1919.

Typical diagram.

Show polarity.

(f) Coils and windings shall be of ..... covered copper wire. 1919.

(g) Transformer case shall be { cast iron / steel } 1919.

(h) Transformers to be in accordance with A. S. A. specification. 1919.

(i) Weight

a. Total net weight including oil ..... 1919.

b. Total shipping weight ..... 1919.

21. *Requisites for single-phase line transformer, oil immersed, self-cooled, A. R. A. specification.*—Continued.

(j) Shall hanger irons be furnished? .....
1919.

(k) Shall case be provided with grounding terminals? ..... 1919.

(l) Inspection and tests.

1. Shall inspections or tests be made at point of production under supervision of Purchaser? .....
1917.

2. ..... days' notice required by Purchaser before apparatus will be ready for inspection or test.
1916.

3. Shall inspection or test be made at destination by Purchaser? ..... 1918.

4. Shall record of inspection and tests as furnished by Contractor be accepted? ..... 1919.

(x) Remarks .....
.....
..... 1916.

(y) Signed ..... 1916.

(z) Date ..... 1916.

SPECIFICATION FOR PORTABLE DIRECT CURRENT VOLT-AMMETERS.

1919.
(Official Approval May, 1920.)

1. *Purpose.*

(a) The purpose of this specification is to provide for portable d.c. volt-ammeters for railway signal testing. (S. S. 1-a.) 1919.

2. *General.*

(a) Instruments shall be made in three combinations:

1. Combination No. 1 for use when a relatively high degree of accuracy is desired and when current measurements are to be made in connection with the testing of high resistance coils for "pick-up" and "drop-away" of the armature. 1919.

2. Combination No. 2 for use when a relatively high degree of accuracy is desired, but an instrument of greater flexibility is required than is possessed by combination No. 1. 1919.

3. Combination No. 3 for use when an instrument of less flexibility than those of combinations Nos. 1 and 2 will be adequate, or when a less expensive instrument is desired. 1919.

3. *Type.*

(a) Instrument shall be of the d'Arsonval type. 1919.

4. *Ranges.*

(a) Instruments shall have all ranges self-contained. 1919.

(b) Ranges for the different combinations shall be as follows:

1. Combination No. 1.

0- .030	amperes	0	3.0	volts.
0- .300	"	0	30.	"
0- 3.00	"			
0-30.0	"			

2. Combination No. 2.

0- .150	amperes	0	3.00	volts.
0- 1.50	"	0	15.0	"
0-15.0	"	0	150.	"

3. Combination No. 3.

0- .300	amperes	0	3.0	volts.
0- 6.00	"	0	30.	"

1919.

SPECIFICATION FOR PORTABLE DIRECT CURRENT VOLT-AMMETERS

1919

(Official Approval May, 1923.)

1. Purpose.

(a) The purpose of this specification is to provide for portable d.c. volt-ammeters for railway signal testing.

2. General.

(a) Instruments shall be made in three combinations:

1. Combination No. 1 for use when a relatively high degree of accuracy is desired and when current measurements are to be made in connection with the testing of high resistance coils for "pick-up" and "drop away" of the armature.

2. Combination No. 2 for use when a relatively high degree of accuracy is desired, but no measurement of greater flexibility is required than is provided by combination No. 1.

3. Combination No. 3 for use when an instrument of less flexibility than those of combinations Nos. 1 and 2 will be adequate, or when a less expensive instrument is desired.

3. Type.

(a) Instrument shall be of the d'Arsonval type.

4. Ranges.

(a) Instruments shall have all ranges self-contained.

(b) Ranges for the different combinations shall be as follows:

1. Combination No. 1.

0- .020 amperes
0- .300 " 3.0 volts.
0- 3.00 "
0- 30.0 "

2. Combination No. 2.

0- .150 amperes 0 3.00 volts.
0- 1.50 " 0 15.0 "
0-15.0 " 0 150. "

3. Combination No. 3.

0- .300 amperes 0 3.0 volts.
0- 6.00 " 0 60. "

1919

5. *Scales.*

(a) Scales for the different combinations shall be in accordance with R.S.A. 1378 as follows:

1. Scale of instruments with minimum scale length of five (5) inches shall consist of one hundred and fifty (150) divisions, of fifteen (15) blocks of ten (10) divisions each. 1919.

2. The scale of instruments with minimum scale length of two and one-half (2½) inches shall consist of sixty (60) divisions of six (6) blocks of ten (10) divisions each. 1919.

(b) The different combinations shall have the following minimum scale lengths:

1. Combination No. 1, five (5) inches. 1919.

2. Combination No. 2, either five (5) or two and one-half (2½) inches. 1919.

3. Combination No. 3, two and one-half (2½) inches. 1919.

(c) Scales shall be hand calibrated and so constructed as not to be affected by moisture or changes in temperature. 1919.

6. *Binding posts.*

(a) Connection to the instrument shall be made on binding posts. 1919.

(b) Binding posts shall be locked in position so they will not turn. They shall be provided with non-removable nuts. 1919.

(c) The polarity of the common terminal binding post shall be positive and so marked. 1919.

7. *Zero adjuster.*

(a) External zero correctors shall be provided on all instruments. 1919.

8. *Pointer.*

(a) Pointer shall have knife edge tip. 1919.

(b) The motion of the pointer shall respond quickly to changes in current or voltage, and shall be practically aperiodic. 1919.

9. *Mirror slot.*

(a) Scale for instruments having minimum scale length of five (5) inches shall be provided with mirror slot directly beneath the knife edge tip of the pointer. 1919.

10. *Movable coil.*

(a) The movable coil shall be provided with hardened and polished steel pivots, which shall operate in highly polished sapphire jewels. 1919.

4. Scales.

(a) Scales for the different combinations shall be in accordance with R.S.A. 1924 as follows:

1. Scale of instruments with minimum scale length of five (5) inches shall consist of one hundred and fifty (150) divisions of fifteen (15) blocks of ten (10) divisions each. 1924.

2. The scale of instrument with minimum scale length of two and one-half (2½) inches shall consist of sixty (60) divisions of six (6) blocks of ten (10) division each. 1924.

(b) The different combinations shall have the following minimum scale lengths:

1. Combination No. 1 five (5) inches. 1924.

2. Combination No. 2 either five (5) or two and one-half (2½) inches. 1924.

3. Combination No. 3 two (2) and one-half (2½) inches. 1924.

(c) Scales shall be fixed or adjusted and so constructed as not to be affected by moisture or changes in temperature. 1924.

5. Binding posts.

(a) Connection to the instrument shall be made on binding posts. 1924.

(b) Binding posts shall be locked in position so they will not turn. They shall be provided with non-removable nuts. 1924.

(c) The polarity of the common terminal binding post shall be positive and so marked. 1924.

7. Zero adjuster.

(a) External zero adjusters shall be provided on all instruments. 1924.

8. Pointer.

(a) Pointer shall have knife edge tip. 1924.

(b) The motion of the pointer shall respond quickly to changes in current or voltage, and shall be practically aperiodic. 1924.

9. Mirror slot.

(a) Scale for instruments having minimum scale length of five (5) inches shall be provided with mirror slot directly beneath the knife edge tip of the pointer. 1924.

10. Movable coil.

(a) The movable coil shall be provided with hardened and polished steel pivots, which shall operate in highly polished sapphire jewels. 1924.

11. *Magnetic shielding.*

(a) Instrument shall be shielded from external magnetic and electrostatic influences. 1919.

12. *Push button.*

(a) When push button is provided it shall be so arranged to lock in the operating position when instrument is used as a voltmeter. 1919.

13. *Heating.*

(a) Instruments shall be capable of being left in the circuit indefinitely at full load without over-heating or showing an appreciable error. 1919.

14. *Case.*

(a) Instruments shall be enclosed in a moisture and dust-proof case which shall have a neat and durable finish. 1919.

15. *Sealing.*

(a) Instruments shall be sealed in such a manner as to prevent any changes or adjustments except by means of the zero adjuster, without breaking the seal. 1919.

16. *Sensitivity.*

(a) Voltmeter ranges of combination No. 1 instruments shall have a sensitivity of not less than one hundred (100) ohms per volt. 1919.

(b) Voltmeter ranges of combination No. 2 instruments shall have a sensitivity of not less than:

1. With a five (5) inch scale, one hundred (100) ohms per volt. 1919.

2. With a two and one-half (2½) inch scale fifty (50) ohms per volt. 1919.

(c) Voltmeter ranges of combination No. 3 instruments shall have a sensitivity of not less than fifty (50) ohms per volt. 1919.

17. *Error due to temperature.*

(a) All voltmeter scales shall be practically compensated for errors due to changes in temperature. 1919.

(b) Ammeter scales for instruments with minimum scale of five (5) inches shall not have an error due to temperature changes in excess of one-half (½) of one (1) per cent. for a change of nine (9) degrees F. below or above the certified temperature. (For example: from sixty-one (61) degrees F. (16° C.) to seventy-nine (79) degrees F. (26° C.). 1919.

(c) Ammeter scale for instruments with minimum scale length of two and one-half (2½) inches shall not have an error due to temperature changes in excess of one (1) per cent. for a change of eight (8) degrees F. below or above the certified temperature. 1919.

11. Magnetic shielding.

(a) Instrument shall be shielded from external magnetic and electrostatic influences. 1919.

12. Push button.

(a) When push button is provided it shall be so arranged to lock in the operating position when instrument is used as a voltmeter. 1919.

13. Heating.

(a) Instruments shall be capable of being left in the circuit indefinitely at full load without over-heating or showing an appreciable error. 1919.

14. Case.

(a) Instruments shall be enclosed in a moisture and dust-proof case which shall have a neat and durable finish. 1919.

15. Sealing.

(a) Instruments shall be sealed in such a manner as to prevent any changes or adjustments except by means of the zero adjuster, without breaking the seal. 1919.

16. Sensitivity.

(a) Voltmeter ranges of combination No. 1 instruments shall have a sensitivity of not less than one hundred (100) ohms per volt. 1919.

(b) Voltmeter ranges of combination No. 2 instruments shall have a sensitivity of not less than:

1. With a five (5) inch scale one hundred (100) ohms per volt. 1919.

2. With a two and one-half (2½) inch scale fifty (50) ohms per volt. 1919.

(c) Voltmeter ranges of combination No. 3 instruments shall have a sensitivity of not less than fifty (50) ohms per volt. 1919.

17. Error due to temperature.

(a) All voltmeter scales shall be practically compensated for errors due to changes in temperature. 1919.

(b) Ammeter scales for instruments with minimum scale of five (5) inches shall not have an error due to temperature changes in excess of one-half (½) of one (1) per cent. for a change of nine (9) degrees F. below or above the certified temperature. (For example) from sixty-one (61) degrees F. (16° C.) to seventy-nine (79) degrees F. (26° C.). 1919.

(c) Ammeter scale for instruments with minimum scale length of two and one-half (2½) inches shall not have an error due to temperature changes in excess of one (1) per cent. for a change of eight (8) degrees F. below or above the certified temperature. 1919.

18. *Accuracy.*

(a) Combination No. 1 instruments shall be accurate to within one-half (½) of one (1) per cent. of full scale value at any part of the scale. 1919.

(b) Combination No. 2 instrument shall be accurate to:

1. When equipped with five (5) inch scale, one-half (½) of one (1) per cent. of full scale value at any part of the scale. 1919.

2. When equipped with two and one-half (2½) inch scale, one (1) per cent. of full scale value at any part of the scale. 1919.

(c) Combination No. 3 instrument shall be accurate to within one (1) per cent. of full scale value at any part of the scale. 1919.

19. *Data for correction.*

(a) Instruments having minimum scale length of five (5) inches shall have certificate securely attached on which is recorded all data essential to their accurate use. 1919.

(b) Instruments having minimum scale length of two and one-half (2½) inches shall have the resistance of voltmeter ranges plainly and permanently marked on the face of the instrument. 1919.

20. *Marking.*

(a) Purchaser's order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of package. (S. S. 9-a.) 1919.

21. *Packing.*

(a) Material shall be so prepared as to permit convenient handling and to protect against loss or damage during shipment. (S. S. 8-a.) 1919.

22. *Tests.*

(a) Tests may be made at point of production, or on samples submitted, and may also be made at destination. (S. S. 7-a.) 1919.

(b) Contractor shall give the Purchaser sufficient notice of time when material will be ready for testing. (S. S. 7-b.) 1919.

(c) Contractor shall provide, at point of production, apparatus and labor for making the required tests under supervision of the Purchaser. (S. S. 7-c.) 1919.

23. *Inspection.*

(a) Purchaser may inspect the material at all stages of manufacture. (S. S. 6-a.) 1919.

23. *Inspection.*—Continued.

(b) Purchaser may inspect the completed product to determine that the requirements of this specification have been met. (S. S. 6-b.) 1919.

(c) If the material has not been accepted at point of production, and if, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected, and the Contractor, upon request, shall advise the Purchaser what disposition is to be made of the defective material. The Contractor shall pay all freight charges. (S. S. 6-c.) 1919.

(d) If Purchaser is to make inspection at point of production, it shall be so stated. (S. S. 6-d.) 1917.

24. *Warranty.*

(a) Contractor shall warrant the material covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to making, at point of production, any part or parts to replace those which shall be found defective within one (1) year after shipment to the Purchaser. This warranty shall not apply to any apparatus which shall have been repaired or altered in any way by anyone other than the Manufacturer thereof so as to, in the Contractor's judgment, affect its proper functioning or reliability nor which has been subject to misuse, negligence or accident. (S. S. 10-a.) 1919.

25. *Material and workmanship.*

(a) Material and workmanship shall be first-class in every respect. (S. S. 5-a.) 1911.

26. *Requisites for direct current portable volt-ammeters, A. R. A. Specification.*

(a) Purchaser to fill in such items as he desires to specify. Manufacturer to fill in all other blanks so that the requisite sheet will be complete when finally submitted with Manufacturer's quotation. 1919.

(b) Instruments shall be in accordance with A.R.A. Specification. 1919.

(c) Identification. Volt-ammeters covered by this sheet are for ..... Railroad on inquiry ..... order ..... requisition ..... 1919.

(d) Number required 1919,

(e) Design.

1. Combination number .....
2. Minimum scale length ..... inches.
3. Shall push button attachment for voltmeter scale be provided? ..... 1919.

23. Inspection.—Continued.

(b) Purchaser may inspect the completed product to determine that the requirements of this specification have been met. (S. S. 6-b.) 1919.

(c) If the material has not been accepted at point of production, and if, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected, and the Contractor, upon request, shall advise the Purchaser what disposition is to be made of the defective material. The Contractor shall pay all freight charges. (S. S. 6-c.) 1919.

(d) If Purchaser is to make inspection at point of production, it shall be so stated (S. S. 6-d.) 1919.

24. Warranty.

(a) Contractor shall warrant the material covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to making, at point of production, any part or parts to replace those which shall be found defective within one (1) year after shipment to the Purchaser. This warranty shall not apply to any apparatus which shall have been repaired or altered in any way by anyone other than the Manufacturer thereof so as to, in the Contractor's judgment, affect its proper functioning or reliability nor which has been subject to misuse, negligence or accident. (S. S. 10-a.) 1919.

25. Materials and workmanship.

(a) Materials and workmanship shall be first-class in every respect. (S. S. 5-a.) 1919.

26. Requisites for direct current portable volt-ammeters. A. R. A. Specification.

(a) Purchaser to fill in such items as he desires to specify. Manufacturer to fill in all other blanks so that the requisite sheet will be complete when finally submitted with Manufacturer's quotation. 1919.

(b) Instruments shall be in accordance with A.R.A. Specification 1919.

(c) Identification Volt-ammeters covered by this sheet are for ..... Railroad on inquiry ..... order ..... requisition ..... 1919.

(d) Number required ..... 1919.

(e) Design.

1. Combination number .....

2. Minimum scale length ..... inches.

3. Shall push button attachment for voltmeter scale be provided? ..... 1919.

26. *Requisites for direct current portable volt-ammeters.*—Con.

(f) Carrying case.

1. Shall leather carrying case be provided? .... 1919.

(g) Inspection or tests.

1. Shall inspection or tests be made at point of production under supervision of Purchaser? ..... 1919.

2. ..... days' notice required by Purchaser before apparatus will be ready for inspection or tests. 1919.

3. Shall records of inspection and tests as furnished by Manufacturer be accepted? ..... 1919.

(x) Remarks .... 1916.

(y) Signed ..... 1916.

(z) Date ..... 1916.

26. Requisites for direct current portable volt-ammeters.—Con.

(f) Carrying case.

1. Shall leather carrying case be provided? .....

..... 1919.

(g) Inspection or tests.

1. Shall inspection or tests be made as part of production under supervision of Purchaser? .....

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3. Shall records of inspection and tests as furnished by Manufacturer be accepted? .....

1919.

(x) Remarks .....

..... 1919.

(y) Signed ..... 1919.

(z) Date ..... 1919.

THE MANUAL

OF THE

American Railroad Association

SIGNAL DIVISION

(Formerly Railway Signal Association)

STANDARD DESIGNS

ISSUE OF 1920

Complete to December 31, 1919

Compiled for the Committee of Direction by the Editing Committee consisting of

H. S. Balliet, Chairman

W. J. Eck, F. P. Patenall,

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Plate 3—locations, insulated joints.	
Plate 4—relay boxes, indicators, etc.	
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Plates 9 and 10—circuit controllers.	
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Plates 5 and 6—interlocked switches and derails.
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Plates 9 and 10—circuit controllers.
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Plate 13—explanatory diagram.
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1019.	Jaws—Tang End and Adjustable Link (Formerly Slotted Jaw, See 1016, 1018M, Nov., 1913)	Dec., 1908	Dec., 1916
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1025.	Crank Bracket Fittings for Pipe Bracket Post (Formerly Link—Solid Steel Forging)	Mar., 1915	
1026.	Ladders—Ground Masts, Mechanical Signals	Dec., 1908	Obsolete.
1027.	Ladders, Top of	Dec., 1908	Obsolete.
1028.	Ladders for Bracket Posts and Mech. Bracket Masts	Dec., 1908	Obsolete.
1029.	Ladder Clamps and Stays	Dec., 1908	Obsolete.
1030.	Bracket Post—Deck for Pipe and Channel Column (Formerly St'd Pipe Signal Post, See 1035, Sept., 1914)	Dec., 1908	May, 1914
1031.	Bracket Post Head and Trunking Cap, Pipe (Formerly St'd Pipe Signal Post, See 1035, Dec.,1915)	Dec., 1908	May, 1914
1032.	Bracket Post—Channel Column (Formerly St'd Pipe Signal Post, See 1035, Dec., 1915)	Oct., 1910	May, 1914
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1035.	Masts, Signal (Formerly Ground Signal Masts)	Mar. 1910	Dec., 1915
1036.	Base for Bridge and Bracket Masts	Mar. 1910	Feb., 1914
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1050.	Pinnacle	Mar., 1910	Feb., 1914
1052.	Ladder Foundation	June. 1910	Dec., 1913
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1027	Ladders—Top of	Dec., 1905	Obsolete
1028.	Ladders for Bracket Posts and Masts—Bracket Masts	Dec., 1905	Obsolete
1029	Lumber Clamps and Stays	Dec., 1905	Obsolete
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1035.	Mast, Signal (Formerly Ground Signal Mast)	May, 1910	Dec., 1913
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1052.	Round Bars and Cones (Formerly Cast—Signal Cranks Soft Primary Battery)	Oct., 1912	June, 1913
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1056.	Terminal Blocks	Mar., 1912	Oct., 1913
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1066.	Crank Stand—Single Vertical, Details and Assembly of	Oct., 1911	Nov., 1913
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1091.	Filler Block—To Limit Travel of Signal Arms	Oct., 1911	Dec., 1913
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1096.	Plunger Lock—Details and Assembly of	Oct., 1911	Aug., 1914
1097.	Dwarf Signal—Mechanical, Assembly of	Oct., 1911	Sept., 1914
1098.	Detector Bars—Details and Assembly of	Mar., 1912	Oct., 1917
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1061.	Locking Short Bearings	Mar., 1912	Dec., 1913
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1063.	Locking Short—Low Bearing	Oct., 1912	Oct., 1913
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1067.	Cross Signal—Double Vertical. Details of	Oct., 1911	May, 1913
1068.	Indicator Stands—Vertical. Details and Assembly of	Oct., 1911	Dec., 1912
1069.	Dwarf Signal Bridge—Single of	Oct., 1912	Oct., 1917
1070.	Finding Post (Formerly No. 1 Washer)	June, 1910	Sept., 1915
1071.	Pipe Carrier Stirrup	July, 1911	Dec., 1913
1072.	Pipe Carrier—Transverse Assembly of	Oct., 1911	Dec., 1913
1073.	Pipe Carrier—Transverse Details of	Oct., 1911	Dec., 1913
1080.	Foundations for Pipe Carrier—Concrete	Dec., 1911	Nov., 1913
1081.	Bearing—Semaphore Mechanical	Jan., 1912	Feb., 1914
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1084	Pipe Carrier Shoe	Oct., 1912	Nov., 1914
1085	Pipe Carrier—Details and Assembly of	June, 1912	Dec., 1917
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1088	Copper—Gravity Battery	June, 1911	Oct., 1913
1089	Cross-arms, Wood	June, 1911	Dec., 1913
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1091	Filler Block—To Limit Travel of Signal Arms	Oct., 1911	Nov., 1913
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1093.	Spectacle Clearance—Diagram of	Dec., 1911	Dec., 1912
1094	Pipe Line Insulator—One-Inch	Oct., 1911	Dec., 1913
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1096.	Plunger Lock—Details and Assembly of	Oct., 1911	Mar., 1913
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1098.	Detector Bars—Details and Assembly of	Oct., 1911	Sept., 1914
1099.	Detector Bar—Position of Clip Bolt (Formerly Detector Bar, No. 1093 Not Issued)	Mar., 1912	Oct., 1913
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1102.	Compensation Chart	Oct., 1909	Oct., 1919
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1104.	Foundation for Compensator, Concrete	Oct., 1909	Mar., 1913
1105.	Foundation for Channel Column Bracket Post, Concrete	Oct., 1909	Oct., 1913
1106.	Foundation for Dwarf Signal, Concrete	Oct., 1909	Mar., 1913
1107.	Foundation for Ground Mast Mechanical Signals	Oct., 1909	May, 1916
1108.	Foundation for Pipe Bracket Post, Concrete	Oct., 1909	Oct., 1913
1109.	Foundation for Pipe Carrier, Concrete	Dec., 1908	Dec., 1909
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1157.	Bootleg, Terminal	Dec., 1911	
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1166.	Pin—Steel, Terminal, Cross-arm	Mar., 1912	Oct., 1912
1167.	Pin Cap Gauge, Cross-arm	Mar., 1912	
1173.	Indication Locking	June, 1912	
1174.	Charging Panels—Line	June, 1912	Sept., 1916
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1181.	Cable Post, Cap and Bushing for	June, 1912	June, 1917
1182.	Relay Box, Cast Iron	June, 1912	June, 1917
1183.	Relay Box Details	June, 1917	Oct., 1917
1184.	Relay Box Details	June, 1917	Oct., 1917
1185.	Relay Boxes and Cable Posts, Assembly of	June, 1912	June, 1917
1189.	Jar, Gravity Cell	Oct., 1913	Obsolete.
1190.	Bracket Post—Mechanical Connections for Six-way	Oct., 1912	
1191.	Bridge and Bracket Masts—Mechanical Connection for Three-arm	Oct., 1912	
1194.	Bearings—Mechanical Semaphore, Details and Assembly of	Oct., 1912	Mar., 1917
1195.	Pipe—One-inch, Operating Fittings	Oct., 1912	Mar., 1917
1196.	Guides for Vertical Connections on Bracket Posts	Oct., 1912	Mar., 1915
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No.	[illegible].	Original.	Latest Rev.
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1104.	Foundation for Combination, Concrete	Oct., 1909	Mar., 1914
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1106.	Foundation for Dwarf Signal, Concrete	Oct., 1909	Mar., 1915
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1159.	Pin—Steel, Terminal, Cross-arm	Mar., 1912	Oct., 1912
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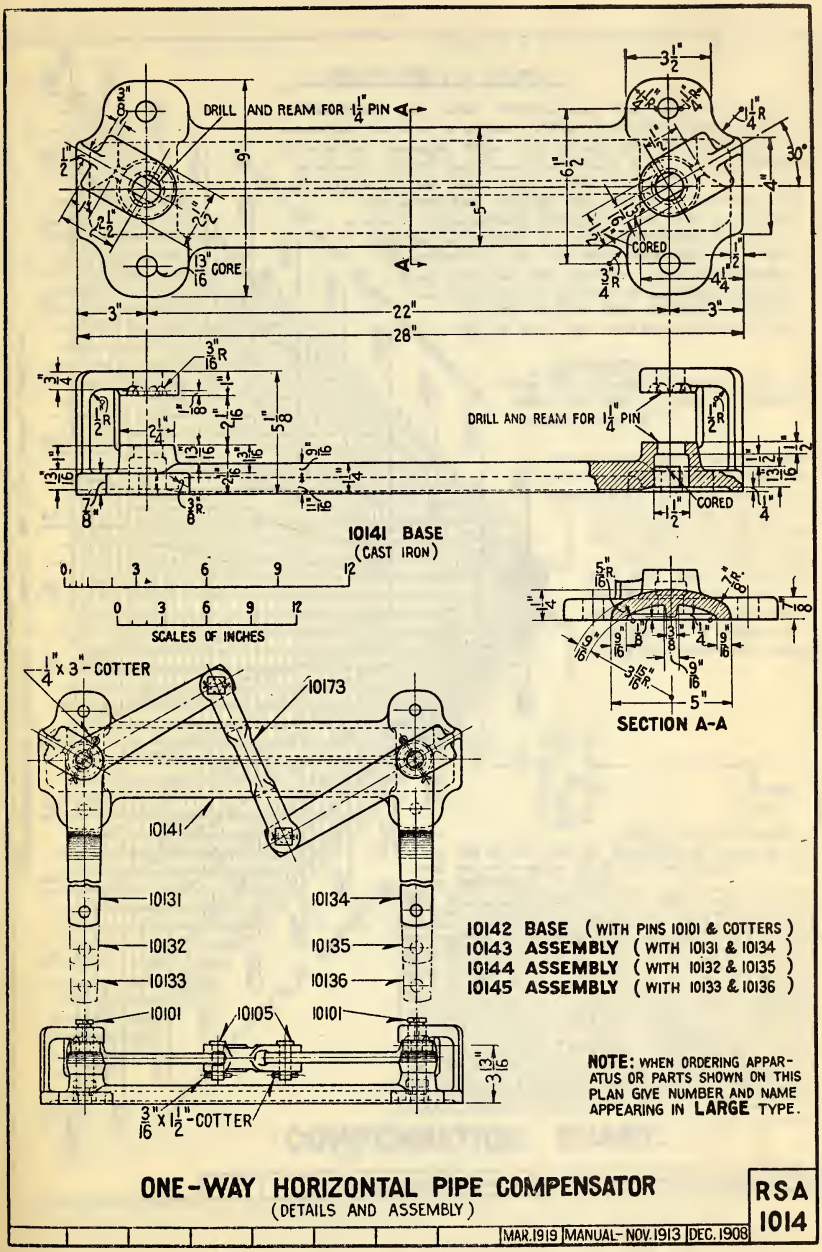
1244.	Semaphore Speed Indicator	May, 1913		
1246.	Signal—Two-way, Cable Lugs	May, 1914	Sept., 1914	
1247.	Lock Rod, Adjustable	May, 1914		
1248.	Marker Light	May, 1914		

No.	TITLE.	Original.	Latest Rev.
1239.	Dwarf Signal Fittings, Mechanical (Formerly Details and Assembly of Switch Box Connections, See 1223)	Oct., 1913	Sept., 1914
1240.	Motor Panel	Mar., 1913	
1241.	Lead Elements	June, 1913	Mar., 1914
1242.	Mercury Arc Rectifier Panel	June, 1913	
1243.	Switchboard Supports	June, 1913	Oct., 1913
1244.	Charging Panels, Electric Interlocking	June, 1913	
1246.	Charging Panels, Circuits for Electric Interlocking	June, 1913	
1247.	Charging Panels, Manipulation Chart for Electric Interlocking	June, 1913	
1248.	Lead Type Portable Storage Battery	Mar., 1916	
1259.	Foundation for Ground Mast Bottom Mechanism Signals	May, 1916	
1309.	Fuses, Cartridge Enclosed	Mar., 1913	Oct., 1914
1329.	Incandescent Electric Lamps	Sept., 1914	
1331.	Pipe Duct, Method of Laying Single and Sewer.	Oct., 1913	Sept., 1914
1332.	Duct Reducers, Mandrels, Duct Plugs and Dowel Pins	Oct., 1913	Sept., 1914
1333.	Manhole Frame, 10″ high, and Cover	Oct., 1913	Sept., 1914
1334.	Cable Hanger Sockets, Sewer Steps and Manhole Clevis	Oct., 1913	Sept., 1914
1335.	Duct, Vitrified Clay	Oct., 1913	
1336.	Duct, Method of Laying Single and Multiple	Oct., 1913	
1337.	Manhole, Concrete	Oct., 1913	Sept., 1914
1338.	Manhole, Brick	Oct., 1913	Sept., 1914
1339.	Manhole Frame, 4″ high, and Cover	May, 1914	Sept., 1914
1340.	Bolt—Storage Battery Connection, Lead Type	Mar., 1914	
1341.	Separator—Storage Battery, Lead Type	Mar., 1914	Sept., 1914
1342.	Box, Concrete—Storage Battery, Iron Details	Mar., 1914	
1343.	Box, Concrete—Storage Battery	Mar., 1914	June, 1918
1344.	Knife Switches and Clips	Mar., 1914	
1345.	Switches, Single Throw	Mar., 1914	
1350.	Chain Wheels, Horizontal	Oct., 1913	
1351.	Chain Wheels, Vertical	Oct., 1913	
1352.	Chain Wheels, Vertical	Oct., 1913	
1355.	Crank Bearings and Clamps	Mar., 1916	
1356.	Bearing, Double Spectacle and Lamp Bracket	Mar., 1916	
1357.	Ladders for Two-way Single-Lamp Signal	Mar., 1916	
1360.	Tang Ends with Screw Jaw	May, 1915	Dec., 1915
1361.	Adjusting Crank and Assembly	May, 1915	
1362.	Ladder Parts—Details	Mar., 1918	Dec., 1918
1363.	Ladder Hand Rails	Mar., 1918	
1364.	Ladder Platforms	Mar., 1918	
1365.	Ladders for Ground Mast Signals.	Mar., 1917	Mar., 1918

No.	TITLE.	Original.		Later Rev.	
1219.	Dwarf Signal Fittings, Mounted (Pictured) Details and Assembly of Switch Box (Concentric Set 1253)	Oct.,	1918	Sept.,	1921
1240.	Motor Panel	Mar.,	1913		
1241.	Lead Elsewhere	June,	1912	Mar.,	1917
1242.	Mercury Arc Rectifier Panel	June,	1912		
1243.	Switchboard Supports	June,	1913	Oct.,	1917
1244.	Charging Panels, Modified Interlocking	June,	1913		
1246.	Charging Panels, Circuits for Electric Interlocking	June,	1913		
1247.	Charging Panels, Manipulation Chart for Electric Interlocking	June,	1913		
1249.	Lead Type Portable Storage Battery	Mar.,	1916		
1250.	Foundation for Ground Coil Bolt	May,	1913		
1305.	Fuses, Cartridge Enclosed	Mar.,	1915	Dec.	1918
1329.	Incandescent Electric Lamps	Sept.,	1913		
1331.	Pipe Duct Method of Laying Single and Sewer.	Oct.	1913	Sept.,	1914
1332.	Duct Reducers, Manhole Duct Plugs and Bond Pins	Oct.,	1913	Sept.,	1914
1333.	Manhole Frame, Cover and Cover	Oct.,	1913	Sept.,	1914
1334.	Cable Hanger Socket, Sewer Strap and Manhole Cleats	Oct.,	1913	Sept.,	1914
1335.	Duct, Vitrified Clay	Oct.,	1913		
1336	Duct Method of Laying Single and Multiple	Oct.,	1913		
1337.	Manhole, Concrete	Oct.,	1913	Sept.,	1914
1338.	Manhole, Brick	Oct.,	1913	Sept.,	1914
1339.	Manhole Frame 4" High and Cover	Nov.,	1913	Sept.,	1914
1340.	Bolt—Stirrup Bolt for Concrete Lead Type	May,	1914		
1341	Separator—Storage Battery, Lead Type	Mar.,	1914	Sept.,	1914
1342.	Box, Quarter—Storage Battery, Iron Dorma	Mar.,	1914		
1343.	Box, Concrete—Storage Battery	Mar.,	1914	June,	1914
1344.	Knife Switches, Main Line	Mar.,	1914		
1345	Switches, Single Throw	Mar.,	1914		
1350.	Chain Wheels, Horizontal	Oct.,	1914		
1351.	Chain Wheels, Vertical	Oct.,	1914		
1352.	Chain Wheels, Vertical	Oct.,	1914		
1356.	Crank Bearings and Clamps	Mar.,	1915		
1376.	Bearing, Thrust Spherical and Lamp Bracket	Mar.,	1918		
1377.	Ladders for Two-Way Side-Lamp Signal	Mar.,	1916		
1380	Tube Made with Screw Joint	May,	1916	Oct.,	1916
1401.	Adjusting Cams and Arrows	May,	1917		
1402.	Ladder Parts—Details	Mar.,	1918	Dec.,	1918
1403	Ladder Head Rail	Mar.,	1918		
1404.	Ladder Platform	Mar.,	1918		
1407.	Ladders for Ground Mast Signals	Mar.,	1917	Mar.,	1918

No.	TITLE.	Original.	Latest Rev.
1366.	Ladders for Bracket Mast Signals.	Mar., 1918	
1367.	Relay Box Inlet Bracket.....	June, 1917	
1368.	Relay Box Linings and Terminal Board	June, 1917	
1369.	Relay Box Fittings.....	June, 1917	Oct., 1917
1371.	Ladder Clamps and Stays—Details and Assembly	Mar., 1917	Dec., 1918
1372.	Ladders for Bracket Posts.....	Mar., 1918	
1374.	Relay Box and Cable Post Mountings	June, 1917	
1375.	Thermometer (Stationary Lead Type Storage Battery).....	Oct., 1917	Nov., 1917
1376.	Double Tang Ends—Details and Assembly	Mar., 1918	
1378.	Scale Ranges for Electrical Instruments	Mar., 1917	
1379.	Charging Panels, Generator.....	Sept., 1916	
1387.	Adapter—Base for Ground Mast Bottom Mechanism Signals.....	May, 1916	Sept., 1916
1388.	Graphical Representation of Electric Energy Supply for Power Interlocking	May, 1915	Sept., 1915
1389.	Graphical Representation of Air Supply for Pneumatic Interlocking	May, 1915	
1390.	Switch Adjustment—Details	May, 1915	Sept., 1916
1391.	Switch Adjustment—Non-insulated	May, 1915	Sept., 1916
1392.	Switch Adjustment—Insulated....	Sept., 1916	
1393.	Crank Stand, Horizontal—Two-way Separate-pin	Sept., 1916	
1394.	Globes—Hand Lantern	Mar., 1917	Dec., 1917
1395.	Electric Lamp Case (For Signals) —Details	Mar., 1917	Dec., 1918
1396.	Stands—Horizontal Adjustable Deflecting	June, 1917	Oct., 1917
1397.	Two-Lever Wall Machine.....	Sept., 1915	Dec., 1915
1398.	Crank Bearings and Clamps for 6" Pipe (For Two-way Single-lamp Signal)	June, 1918	
1399.	Low Target Stand.....	Mar., 1916	
1400.	Turn in Pipe Run.....	Mar., 1916	June, 1916
1402.	Leadaway	Mar., 1916	June, 1916
1420.	Circuits for Line Charging Panels.	Sept., 1916	
1422.	Adjustable Resistance (For Testing)	June, 1918	
1424.	Lightning Arrester Grounds.....	Mar., 1917	Nov., 1917
1459.	Staff Tip Adapter.....	Sept., 1919	
1460.	Switch Lamp	Sept., 1919	
1461.	Switch Lamp Base-Socket.....	Sept., 1919	

No.	TITLE	Original.	Latest Rev.
1146	Ladders for Bracket Mast Signals	Mar., 1918	
1147.	Relay Hot Inlet Bracket	June, 1917	
1148.	Relay Box Lamps and Terminal Board	June, 1917	
1149.	Relay Box Fittings	June, 1917	Oct., 1917
1171	Ladder Clamps and Stay—Details and Assembly	Mar., 1917	Dec., 1918
1172.	Ladders for Bracket Masts	Mar., 1918	
1174	Relay Box and Cable Post Mount	June, 1917	
1176.	Thermometer (Stationary Type Storage Battery)	Oct., 1917	Nov., 1917
1176.	Double Tank Rods—Details and Assembly	Mar., 1918	
1178.	Scale Ranges for Electrical Instruments	Mar., 1917	
1179	Charging Panel, Generator	Sept., 1918	
1180.	Adapter—Base for Ground Mast	May, 1918	Sept., 1918
1183.	Interlocking Mechanism Signal		
1184.	Graphical Representation of Electric Energy Supply for Power Interlocking	May, 1918	Sept., 1918
1185	Graphical Representation of Air Supply for Pneumatic Interlocking	May, 1918	
1186.	Switch Adjustment—Details	May, 1918	Sept., 1918
1187.	Switch Adjustment—Non-insulated	May, 1918	Sept., 1918
1188.	Switch Adjustment—Insulated	Sept., 1918	
1203	Crank Stand, Horizontal—Two-way Separation	Sept., 1918	
1204.	Guide—Hand Lantern	Mar., 1917	Dec., 1917
1206.	Electric Lamp Case (For Signals) —Details	Mar., 1917	Dec., 1918
1208.	Stands—Horizontal Adjustable Section	June, 1918	Oct., 1918
1237.	Two-Lever Wall Machine	Sept., 1918	Dec., 1918
1238.	Crank Bearings and Clamps for 5" Pipe (For Two-way Semaphore Signal)	June, 1918	
1239.	Low Target Stand	Mar., 1918	
1169.	Turn in Pipe Run	Mar., 1918	June, 1918
1162.	Roadway	Mar., 1918	June, 1918
1170	Circuits for Line Clearing Points	Sept., 1918	
1132.	Adjustable Resistance (For Testing)	June, 1918	
1124.	Lightning Arrester Grounds	May, 1917	Nov., 1917
1125.	Stub Tip Adapter	Sept., 1918	
1160	Switch Lamp	Sept., 1918	
1161	Switch Lamp Post Socket	Sept., 1918	



ONE-WAY HORIZONTAL PIPE COMPENSATOR

(DETAILS AND ASSEMBLY)

RSA 1014

MAR. 1919 | MANUAL - NOV. 1913 | DEC. 1908

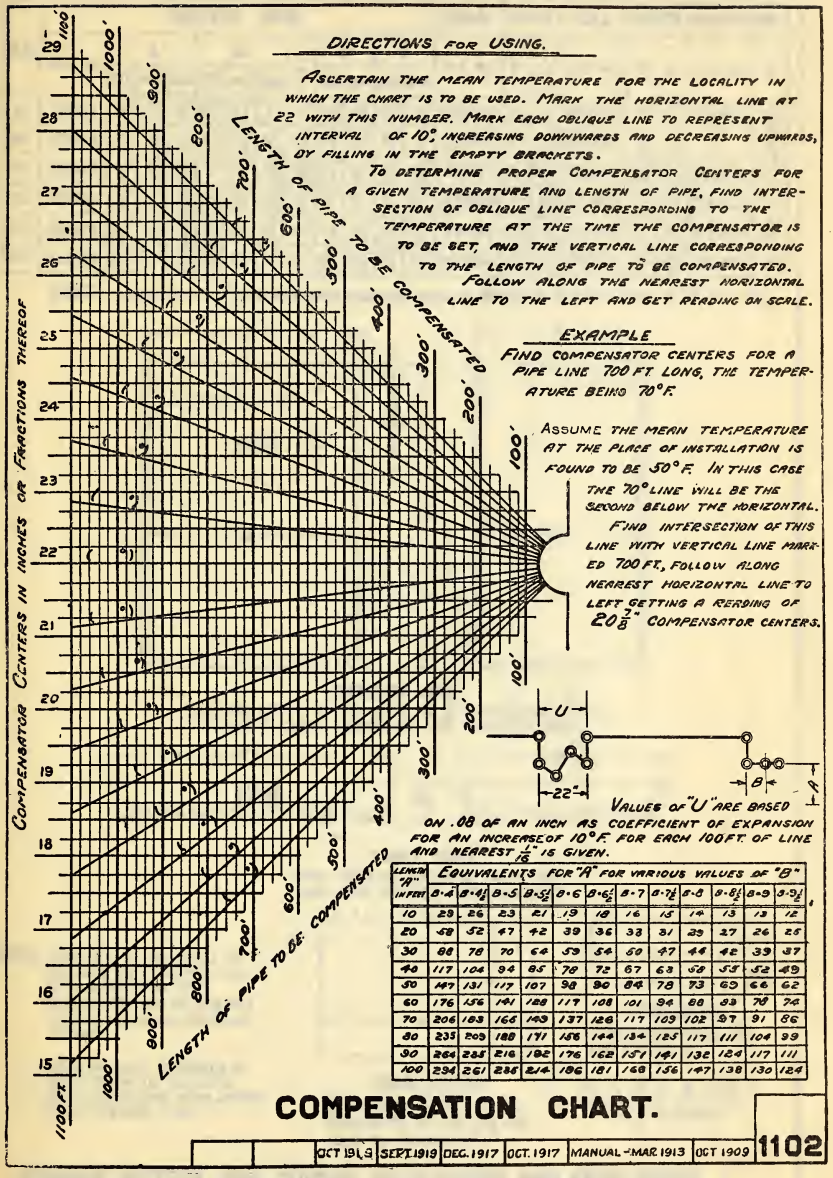
10142 BASE (WITH PINS 10IX & COTTER)
10143 ASSEMBLY (WITH 10136 & 10134)
10144 ASSEMBLY (WITH 10132 & 10139)
10145 ASSEMBLY (WITH 10139 & 10135)

NOTE: WHEN SPECIFYING REPAIR
PARTS OR PARTS SHOWN ON THIS
PLATE, GIVE NUMBERS AND NAME
OF CASTING IN LARGE TYPE.

ONE-WAY HORIZONTAL PIPE COMPENSATOR

(DETAILS AND ASSEMBLY)

RSA
1014


DIRECTIONS FOR USING.
Ascertain the mean temperature for the locality in which the chart is to be used. Mark the horizontal line at 22 with this number. Mark each oblique line to represent interval of 10° increasing downwards and decreasing upwards, by filling in the empty brackets.
To determine proper Compensator Centers for a given temperature and length of pipe, find intersection of oblique line corresponding to the temperature at the time the compensator is to be set, and the vertical line corresponding to the length of pipe to be compensated. Follow along the nearest horizontal line to the left and get reading on scale.
EXAMPLE
Find compensator centers for a pipe line 700 ft long, the temperature being 70° F.
Assume the mean temperature at the place of installation is found to be 50° F. In this case the 70° line will be the second below the horizontal.
Find intersection of this line with vertical line marked 700 ft, Follow along nearest horizontal line to left getting a reading of 20 3/8" Compensator centers.
Compensator Centers in inches or Fractions thereof
Length of Pipe to be Compensated
1100 Ft
U
B
A
22"
Values of "U" are based on .08 of an inch as coefficient of expansion for an increase of 10° F. for each 100 ft. of line and nearest 1/16" is given.

Length "A" in Feet	Equivalents for "A" for various values of "B"											
	8·4	8·4½	8·5	8·5½	8·6	8·6½	8·7	8·7½	8·8	8·8½	8·9	8·9½
10	29	26	23	21	19	18	16	15	14	13	13	12
20	58	52	47	42	39	36	33	31	29	27	26	25
30	88	78	70	64	59	54	50	47	44	42	39	37
40	117	104	94	85	78	72	67	63	58	55	52	49
50	147	131	117	107	98	90	84	78	73	69	66	62
60	176	156	141	128	117	108	101	94	88	83	78	74
70	206	183	166	149	137	126	117	109	102	97	91	86
80	235	209	188	171	156	144	134	125	117	111	104	99
90	264	235	216	192	176	162	151	141	132	124	117	111
100	294	261	286	214	196	181	168	156	147	138	130	124

COMPENSATION CHART.

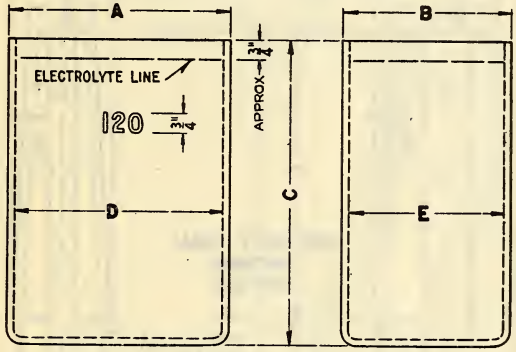
		OCT 1913	SEPT 1919	DEC. 1917	OCT. 1917	MANUAL - MAR 1913	OCT 1909

1102

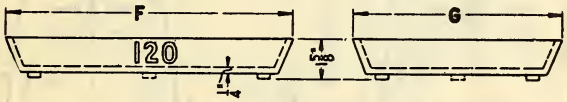
COMPENSATION CHART.

A.H.	BATTERY JARS										SAND TRAYS			CELL COVERS			HOLD-DOWNS	
	REF. NO.	A			B			C	D		E		REF. NO.	F	G	REF. NO.	H	J	REF. NO.	K
		STD.	MIN.	MAX.	STD.	MIN.	MAX.		MIN.	MAX.	MIN.	MAX.								
40	12241	7 3/8"	7 1/4"	7 5/8"	4 3/4"	4 5/8"	5"	11"	6 5/8"	7 3/8"	4 1/8"	5 1/4"	122401	9 1/8"	6 1/2"	122411	4"	6 1/2"	122421	3 7/8"
80	12242	9 1/4"	9 1/8"	9 1/2"	5 1/2"	5 3/8"	5 3/4"	12 3/4"	8 1/2"	9 1/4"	4 3/4"	6"	122402	11"	7 1/4"	122412	5 3/4"	7 1/4"	"	3 7/8"
120	12243	9 1/4"	9 1/8"	9 1/2"	7"	6 7/8"	7 1/4"	12 3/4"	8 1/2"	9 1/4"	6 1/4"	7 1/2"	122403	11"	8 3/4"	122413	5 3/4"	8 3/4"	122422	5 1/2"
200	12244	9 1/4"	9 1/8"	9 1/2"	10 5/8"	10 1/2"	10 7/8"	12 3/4"	8 1/2"	9 1/4"	9 7/8"	11 1/4"	122404	11"	12 3/8"	122414	5 3/4"	12 3/8"	122423	9"
240	12245	12 3/8"	12 1/4"	12 5/8"	7 3/8"	7 1/4"	7 5/8"	17"	11 1/2"	12 3/8"	6 5/8"	7 7/8"	122405	14 1/8"	9 1/8"	122415	8 1/2"	9 1/8"	122424	6 1/2"
400	12246	12 3/8"	12 1/4"	12 5/8"	10 5/8"	10 1/2"	11"	17"	11 1/2"	12 3/8"	9 7/8"	11 1/2"	122406	14 1/8"	12 3/8"	122416	8 1/2"	12 3/8"	122423	9"

NOTE: A VARIATION OF $\frac{1}{4}$" EACH WAY FROM STANDARD SHALL BE PERMITTED IN DIMENSIONS **'C' 'F'** AND **'G'**.



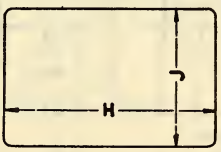
BATTERY JAR.
SIDES AND BOTTOM OF JAR SHALL BE $\frac{1}{4}$" THICK, ($\frac{1}{8}$" MIN., $\frac{3}{8}$" MAX.) AND SHALL BE CLEAR, UNIFORM AND FREE FROM BLOW HOLES.



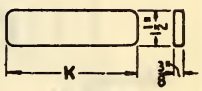
SAND TRAY.
SAND TRAYS FOR 240 A.H. AND 400 A.H. JARS SHALL HAVE NINE (9) INSULATOR FEET.

NOTES: CAPACITY OF JAR SHALL BE MOULDED OR ETCHED IN GLASS OF JAR AND SAND TRAY. CELL COVERS AND HOLD-DOWNS SHALL HAVE ROUNDED EDGES AND CORNERS.

WHEN ORDERING APPARATUS OR PARTS SHOWN ON THIS PLAN, GIVE NUMBER AND NAME APPEARING IN **LARGE** TYPE.



CELL COVER.
SHEET GLASS $\frac{3}{16}$" TO $\frac{1}{4}$" THICK, CORRUGATED ON ONE SIDE PARALLEL TO DIMENSION **'J'**.



HOLD-DOWN.
2 REQ'D FOR 240 A.H. AND 400 A.H. CELLS.

0 1 2 3 4 5 6
SCALE OF INCHES.

STORAGE BATTERY JARS, COVERS, HOLD-DOWNS AND SAND TRAYS.

STATIONARY TYPE.

									DEC. 1919	MAR. 1915	SEPT. 1914	OCT. 1912	1224

American Railroad Association
Signal Division

STORAGE BATTERY JARS, COVERS, MOLD-DOWNS AND SAND TRAYS.

STATIONARY TYPE

A.H.	BATTERY JARS												SAND TRAYS			CELL COVERS			MOLD-DOWNS	
	REF. NO	A		B		C	D		E				REF. NO	F	G	REF. NO	H	J	REF. NO	K
		STD.	MIN.	MAX.	STD.	MIN.	MAX.	MIN.	MAX.	STD.	MIN.	MAX.								
40	12241	7/8	13/16	1	4 1/4	4 1/8	5	11		5 1/4	5 1/8	5 3/8	122401	5 1/4	5 1/2	12241	4	5 1/4	12241	3 1/2
80	12242	1 3/16	1 1/16	1 1/4	5 1/4	5 1/8	6	12		6 1/4	6 1/8	6 3/8	122402	6 1/4	6 1/2	12242	5	6 1/4	"	4
120	12243	1 1/16	1	1 1/8	6 1/4	6 1/8	7	12 1/2		7 1/4	7 1/8	7 3/8	122403	7 1/4	7 1/2	12243	6	7 1/4	12243	4 1/2
200	12244	1 1/4	1 3/16	1 5/16	7 1/4	7 1/8	8	13		8 1/4	8 1/8	8 3/8	122404	8 1/4	8 1/2	12244	7	8 1/4	12244	5 1/2
240	12245	1 5/16	1 1/4	1 7/16	8 1/4	8 1/8	9	13 1/2		9 1/4	9 1/8	9 3/8	122405	9 1/4	9 1/2	12245	8	9 1/4	12245	6 1/2
400	12246	1 7/8	1 13/16	2	10 1/4	10 1/8	11	17		11 1/4	11 1/8	11 3/8	122406	11 1/4	11 1/2	12246	10	11 1/4	12246	9

NOTE: A VARIATION OF $\frac{1}{16}$" FROM STANDARD SHALL BE PERMITTED IN DIMENSIONS "C", "E" AND "G".

BATTERY JAR.

SAND TRAY.

MOLD-DOWN.

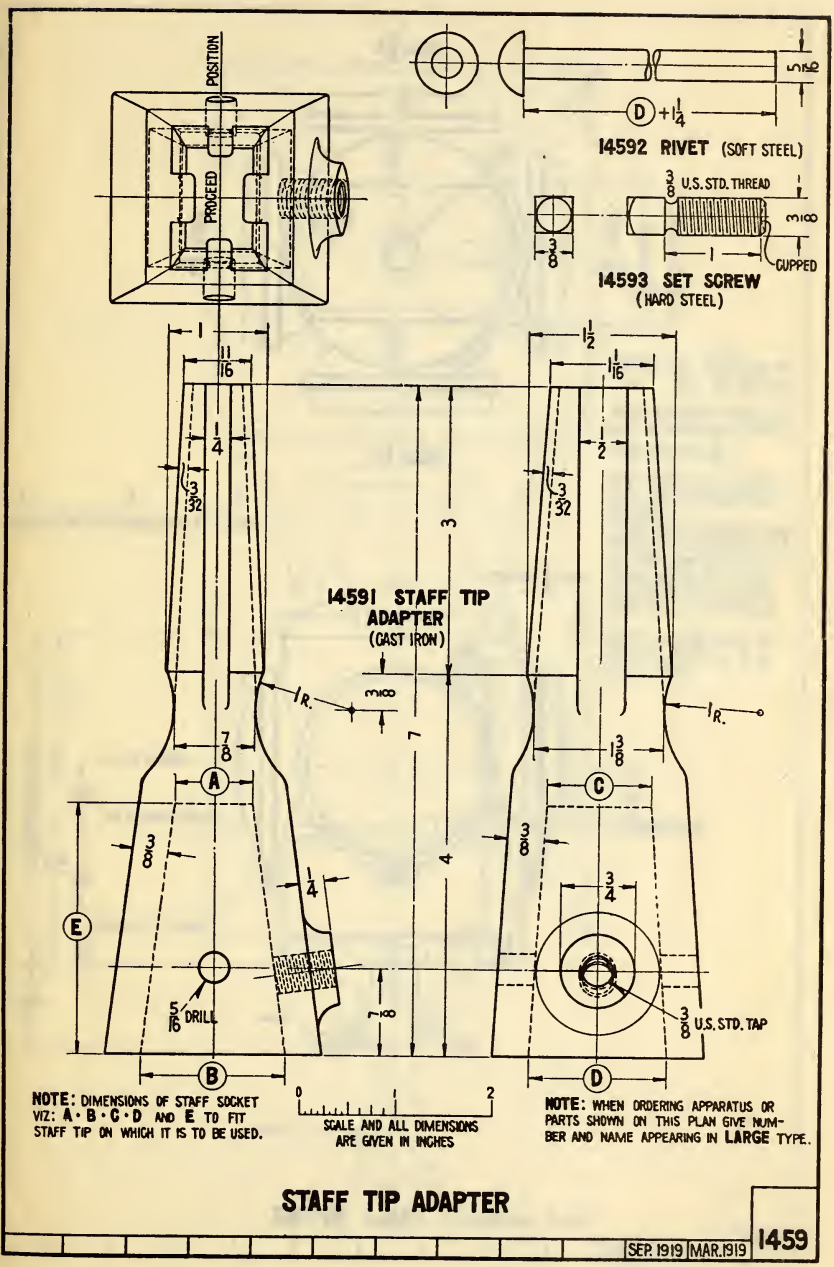
CELL COVER.

SCALE OF INCHES

NOTES: CAPACITY OF JAR BASED ON MOULDED OR ETCHED IN GLASS OF JAR AND SAND TRAY.
CELL COVERS AND HOLE LOCATIONS SHALL HAVE BEEN PRIOR TO DECEMBER

WHEN ORDERING APPARATUS IN PARTS SHOWN ON THIS PLAN, GIVE NUMBER AND NAME APPEARING IN LARGE TYPE

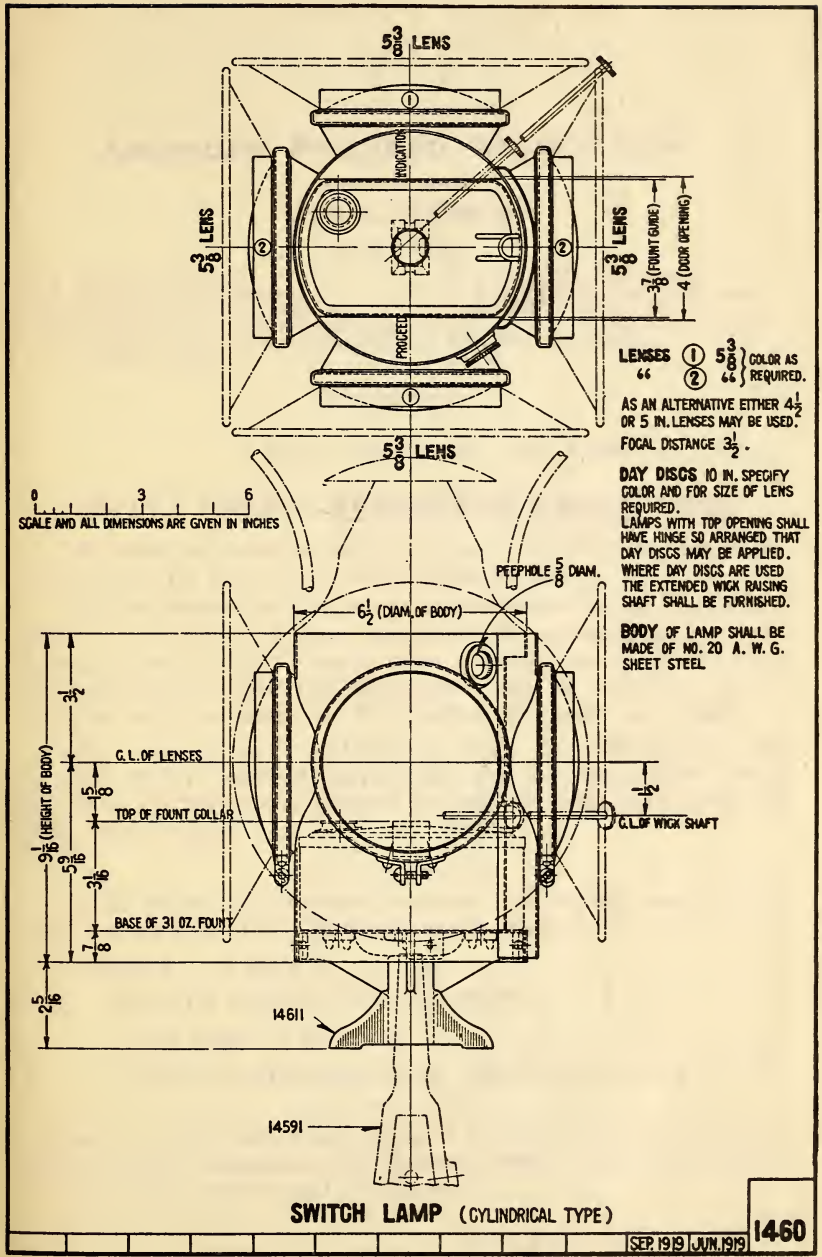
American Railroad Association.
Signal Division.


POSITION
PROCEED
14592 RIVET (SOFT STEEL)
U.S. STD. THREAD
CUPPED
14593 SET SCREW
(HARD STEEL)
14591 STAFF TIP
ADAPTER
(CAST IRON)
DRILL
U.S. STD. TAP
NOTE: DIMENSIONS OF STAFF SOCKET VIZ: A · B · C · D AND E TO FIT STAFF TIP ON WHICH IT IS TO BE USED.
SCALE AND ALL DIMENSIONS ARE GIVEN IN INCHES
NOTE: WHEN ORDERING APPARATUS OR PARTS SHOWN ON THIS PLAN GIVE NUMBER AND NAME APPEARING IN LARGE TYPE.

STAFF TIP ADAPTER

SEP. 1919 MAR. 1919 **1459**

STAFF TIP ADAPTER



LENSES ① $5\frac{3}{8}$ } COLOR AS
" ② " } REQUIRED.

AS AN ALTERNATIVE EITHER $4\frac{1}{2}$ OR 5 IN. LENSES MAY BE USED.

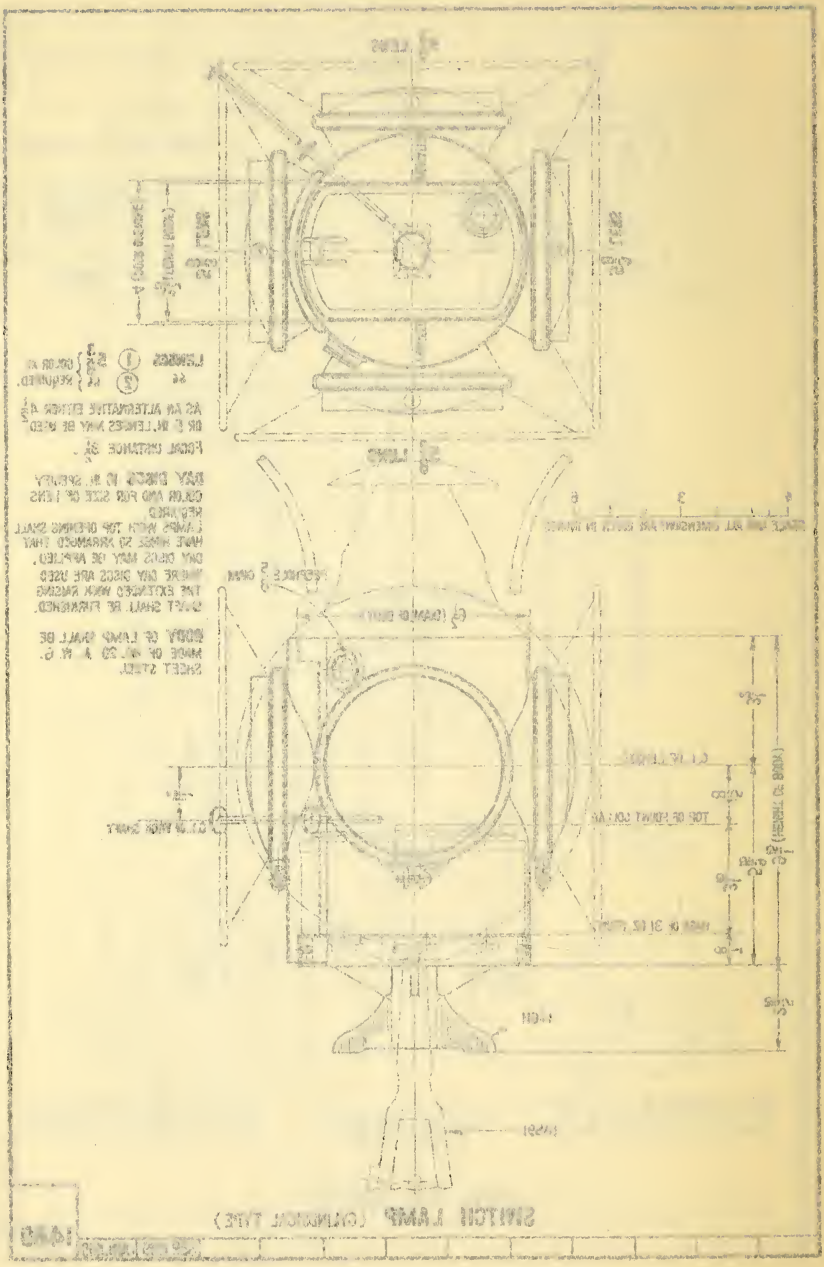
FOCAL DISTANCE $3\frac{1}{2}$.

DAY DISCS 10 IN. SPECIFY COLOR AND FOR SIZE OF LENS REQUIRED.
LAMPS WITH TOP OPENING SHALL HAVE HINGE SO ARRANGED THAT DAY DISCS MAY BE APPLIED. WHERE DAY DISCS ARE USED THE EXTENDED WICK RAISING SHAFT SHALL BE FURNISHED.

BODY OF LAMP SHALL BE MADE OF NO. 20 A. W. G. SHEET STEEL

SWITCH LAMP (CYLINDRICAL TYPE)

SEP. 1919 JUN. 1919 **1460**



AMERICAN RAILROAD ASSOCIATION

SIGNAL DIVISION

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H. S. BALLIET, Secretary

75 Church Street, New York, August 15, 1920.

ERRATA SHEET--REVISION OF MANUAL, 1920

This sheet is issued to correct certain irregularities existing in ALL MANUALS and in the 1920 Instruction Sheet.

Will you please check all of the subjects listed in the Instruction sheet and determine whether your Manual corresponds in all respects. If you find any irregularities we would be pleased to have you communicate with the undersigned and we will make a determined effort to assist you in bringing your issue up to date.

THE SECRETARY BELIEVES THIS IS IMPORTANT IN ORDER THAT THERE MAY BE NO OPPORTUNITY FOR IRREGULARITITES TO CREEP IN OR BE PERPETUATED IF THEY NOW EXIST.

Kindly study the following carefully and adjust your Manual after inserting the 1920 Additions and Revisions:

DESTROY 1915 issue of

CONDUIT, FIBRE, SPECIFICATION,

and insert in its place

CONDUIT, Impregnated, Fibre—Specification—Issue of 1918.

Page 7, 1920 Instruction Sheet is in error where it is stated "Wire, Rubber Insulated—Specification—**Five** sheets—No change. Five sheets, should read: **Six** sheets.

H. S. BALLIET,
Secretary.

AMERICAN RAILROAD ASSOCIATION
SIGNAL DIVISION

REVISION OF MANUAL, 1920.

Approved by General Committee, Section II—Engineering
March, 1920.

Approved by Executive Committee—May, 1920.

IMPORTANT—READ CAREFULLY.

This Index has been prepared for the purpose of rearranging the Manual. Enclosed herewith will be found all subject matter adopted by letter ballot January 10, 1920, this material having been submitted for such action at the 1919 Annual Meeting.

Prior to placing this matter in the Manual it should be carefully noted if all previous revisions have been inserted. If not, it is necessary that this be done prior to inserting the Revisions as of 1920. In order to make it clear the following guide is presented:

In the First Issue of the Manual (1912), the Title Page will show,
"First Edition, 1912."

For 1913 the Title Page will show,
"Second Edition,
Revised 1913."

For 1914 the Title Page will show,
"Second Edition,
Revised 1913."
Revised 1914."

For 1915 the Title Page will show,
"Third Edition,
Including subject matter approved January 5, 1915."

For 1916 the Title Page will show,
"Third Edition,
Including subject matter approved January 10, 1916."

For 1917 the Title Page will show,
"Issue of 1917,
Complete to December 31, 1916."

For 1918 the Title Page will show,
"Issue of 1918,
Complete to December 31, 1917."

For 1919 the Title Page will show,
"Issue of 1919,
Complete to December 31, 1918."

For 1920 the Title Page will show,
"Issue of 1920,
Complete to December 31, 1919."

It will be noted from above that there have been Additions and Revisions prepared every year since 1912, and these should be placed in the Manual in the order in which they were issued.

It must be understood that such portions of existing matter now in the Manual that have not been affected by any revision, or have not become obsolete, are to remain intact; where revisions have been made to any sheet or sheets in existing specifications it will be necessary to substitute such sheet or sheets.

The instructions, as shown on the following pages, are intended as a guide for inserting all new matter, substituting Revisions and

removing all obsolete matter, if carefully followed will bring the Manual up to date.

In order to differentiate between new, revised and obsolete matter, the following terms are used:

INSERT.—New matter not previously shown.

SUBSTITUTE.—Existing matter to be removed and revision inserted.

NO CHANGE.—Existing matter to be left in its present location.

OBSOLETE.—Matter that has either been incorporated elsewhere or superseded by new matter; such sheets are to be taken out.

INSTRUCTIONS FOR INSERTING SUBJECT MATTER ADOPTED JANUARY, 1920.

Care must be exercised where matter is to be substituted, to be sure that only the sheets affected by the change are removed before the new matter is inserted, as in some cases the original may consist of two or more sheets, whereas the revision may be confined to one sheet, or vice versa.

Existing matter to remain in Manual will be shown in light face type.

New matter and Revisions to existing matter now in Manual will be shown in **black face type.**

New matter and Revisions found in this package to be inserted as follows:

SPECIFICATIONS.

Title Page, Issue of 1920—One sheet—Substitute.

Preface—One sheet—Substitute.

Contents—Sheets 1 to 5, inclusive—Five Sheets—Substitute.

Sub-Division Sheet A-B—One sheet—Obsolete.

Abbreviations—Two sheets—No change.

Alternator—Specification—Nine Sheets—Substitute.

Automatic Block Signal System, a.c., using a.c. for Propulsion.
- Index—Three sheets—No change.
- Specification—Paging 1 to 36—Twenty-one sheets—No change.
- See Index to Major Specifications, January 10, 1918—No change.
- See Index to Major Specifications, January 18, 1919—No change.

Automatic Block Signal System, a.c., using d.c. for Propulsion.
- Index—Four sheets—No change.
- Specification—Paging 1 to 32—Twenty-one sheets—No change.
- See Index to Major Specifications, January 10, 1918—No change.
- See Index to Major Specifications, January 18, 1919—No change.

Automatic Block Signal System, a.c. Steam Railways, etc.
- Index—Four sheets—No change.
- Specification—Paging 1 to 34—Twenty-one sheets—No change.
- See Index to Major Specifications, January 10, 1918—No change.
- See Index to Major Specifications, January 18, 1919—No change.

Automatic Block Signals Operated by Direct Current.
Index—Four sheets—No change.
Specification—Paging 1 to 22—Twenty-two sheets—No change.
See Index to Major Specifications, January 10, 1918—No change.
See Index to Major Specifications, January 18, 1919—No change.

Battery, Primary—Specifications.
Caustic Soda Cells and Renewals—Two sheets—No change.
Caustic Soda, Instructions—Three sheets—Insert.
Coppers—One sheet— No change.
Jar—Three sheets—Insert.
Zincs—One sheet—No change.

Battery, Storage.
Battery Box, Concrete—Specification—Two sheets—No change.
Charged from Primary Cells—Instructions—One sheet—No change.
Electrolyte for Lead Type—One sheet—No change.
Installation of Lead Type—Directions for—Three sheets—No change.
Operation at Interlocking Plants—Instructions—Two sheets—No change.
Operation in Block Signal Service—Instructions—Two sheets—No change.
Nickel, Iron, Alkaline—Specification—Three sheets—No change.
Nickel, Iron, Alkaline—Instructions—Four sheets—No change.
Installation of Lead Covered Portable—Directions—One sheet—No change.
Operation of Lead Type Portable—Instructions—Two sheets—No change.
Lead Type Portable—Specification—Six sheets—No change.
Place R.S.A. 1248 with Standard Designs.
Composite Type Stationary—Specification—Three sheets—No change.
Lead Type Stationary—(Pure Lead Type)—Specification—Three sheets—No change.
Lead Type Stationary—(Not Pure Lead Type)—Specification—One sheet—No change.
Installation of Lead Type Stationary—Directions—Two sheets—No change.

Bell, Annunciator—Specification—One sheet—No change.

Bell, D.C. Vibrating—Specification—Two sheets—No change.

Bridges, Movable, Protection of—Requirements—Three sheets—No change.

Subdivision Sheet C-E—One sheet—Obsolete.

Cable—Specifications:
Aerial Aluminum—Three sheets—No change.
Aerial Braided, 660 Volts—Six sheets—No change.
Armored Submarine, 660 Volts—Eight sheets—No change.
Armored Submarine, 2200 Volts—Eight sheets—No change.
Lead Covered, 660 Volts—Seven sheets—No change.
Lead Covered, 2200 Volts—Seven sheets—No change.
Underground Braided, 660 Volts—Six sheets—No change.

Channel Pins—Specification—Two sheets—No change.

Circuit Nomenclature—Six sheets—No change.

Clearance Diagram—One sheet—No change.

Concrete—Specification—Two sheets—No change.

Conduit—Specifications:
- Fibre—Two sheets—No change.
- Fibre and Metal Systems—Installation—Four sheets—No change.
- Pipe, Steel—Two sheets—No change.
- Pipe, Wrought Iron—Two sheets—No change.
- Vitrified Clay—Two sheets—No change.
- Vitrified Clay System—Installation—Three sheets—No change.

Copper Sulphate—Specification—One sheet—No change.

Crossarms, Wood—Specification—Two sheets—No change.

Crossarm Braces, etc.—Specification—One sheet—No change.

Crossarm Pins, Steel—Specification—Two sheets—No change.

Crossarm Through Bolts, etc.—Specification—One sheet—No change.

Definitions for Technical Terms—Two sheets—No change.

Designs, Standard Drawings—See separate list. It is recommended that drawings be placed in a separate volume in numerical order.

Engine, Gasoline, etc.—Specification—One sheet—No change.

Subdivision Sheet F-L—One sheet—Obsolete.

Fibre, Hard—Specification—One sheet—Insert—Should have remained in last year's issue.

Fibre, Conduit—Impregnated—Specification—Five sheets—No change.

Forms for Recording Signal Performance—Five sheets—No change.

Fuses—Specification—Two sheets—No change.

Galvanizing for Iron or Steel—Specification—Two sheets—No change.

General Electrical Requirements—One sheet—Substitute.

General Provisions, Major Specifications—Seven Sheets—Substitute.

Generator, Electric—Specification—One sheet—No change.

Generator, Electric, A.C.—Specification—Four sheets—Obsolete.

Globes, Hand Lantern—Specification—Four sheets—No change.

Impedance Bond—Specification—Seven sheets—Substitute.

Impregnation Treatment, Coils and Windings—Specification—Two sheets—No change.

Indications, Principles of Signal—One sheet—No change.

Indicator, Take Siding—Two cuts—Instructions—Three sheets—No change.

Indicators, Switch-Requisites—Two sheets—No change.

Instructions for Testing and Maintaining Dry Cells—One sheet—No change.

Instructions for Maintenance of Gravity Cells—Two sheets—No change.

Instructions for Maintenance of Caustic Soda Cells—Two sheets—No change.

Instruments—Ranges and Scales (two cuts)—Three sheets—No change.

Interlocking, Electric.
Index—Four sheets—No change.
Specification—Paging 1 to 33—Eighteen sheets—No change.
See Index to Major Specifications, January 10, 1918—No change.
See Index to Major Specifications, January 18, 1919—No change.

Interlocking, Electromechanical.
Index—Six sheets—No change.
Specification—Paging 1 to 37—Thirty-seven sheets—No change.
See Index to Major Specifications, January 10, 1918—No change.
See Index to Major Specifications, January 18, 1919—No change.

Interlocking, Electropneumatic.
Index—Four sheets—No change.
Specification—Paging 1 to 36—Twenty-two sheets—No change.
See Index to Major Specifications, January 10, 1918—No change.
See Index to Major Specifications, January 18, 1919—No change.

Interlocking, Mechanical.
Index—Three sheets—No change.
Specification—Paging 1 to 19—Nineteen sheets—No change.
See Index to Major Specifications, January 10, 1918—No change.
See Index to Major Specifications, January 18, 1919—No change.

Interlocking.
Mechanical Machine, Requisites—One sheet—Insert.
Mechanical Machine, Saxby and Farmer—Specification—Nine sheets—Insert.
Power, Machine—Specification—Eight sheets—Insert.

Iron, Gray Castings—Specification— One sheet—No change.

Iron, Malleable Castings—Specification—One sheet—No change.

Iron, Wrought Bars—Specification—One sheet—No change.

Lamps, Incandescent Electric—Four sheets—No change.

Lightning Protection:
Arresters, Made Ground Apparatus—Specifications—Three sheets—No change.
Arresters—Requisites—One sheet—No change.
Choke Coils—Requisites—One sheet—No change.
Vacuum Gap Arresters—Specification—Two sheets—No change.

Subdivision Sheet M-S—One sheet—Obsolete.

Oil, Illuminating—Specification—One sheet—No change.

Oil, Transformer—Specification—One sheet—No change.

Overlaps in Automatic Signal Systems—One sheet—No change.

Paint and Painting—Specification—Four sheets—No change.

Petrolatum for Use in Impedance Bonds—Specification—Three sheets—Substitute.

Petroleum Asphaltum—Specification—Three sheets—No change.

Phrases and Words—One sheet—Insert.

Pipe Compensation—Specification—Two sheets—No change.

Pipe, Soft Steel—Specification—One sheet—No change.

Pipe, Wrought Iron—Specification—One sheet—No change.

Poles, White Cedar—Specification— Two sheets—No change.

Push Buttons—Specification—One sheet—No change.

Pushes, Floor—Specification—One sheet—No change.

Reactor—Specification—Five sheets—No change.

Relay, A.C.—Specification—Nine sheets—Substitute.

Relay, D.C.—Neutral Type—Specification—Three sheets—No change.

Relays, D.C.—Use of—One sheet—No change.

Relays, D.C.—Table of Minimum Resistance—One sheet—No change.

Releases, Mech. and Elec.—Specification—One sheet—No change.

Resistors for Line and Track Circuits—Specification—Five sheets—No change.

Roundels, Lenses and Glass Slides—Specification—Six sheets— No change.

Rules Governing Maintenance of Block Signals—One sheet—No change.

Rules Governing Maintenance at Interlocking Plants—Six sheets—No change.

Rules Governing Signal Foremen—One sheet—No change.

Rules Governing Signal Maintainers—Two sheets—No change.

Rules Governing Signal Supervisors—One sheet—No change.

Signs or Markers for Enginemen—Sixteen sheets—No change.

Signal, A.C. Motor Semaphore—Specification—Eleven sheets—Substitute.

Signal, D.C. Motor Semaphore—Specification—Four sheets—No change.

Signal, Electric Color Light—Specification—Seven Sheets—Insert.

Signal, Electric Position Light—Specification—Seven sheets—Insert.

Signaling Practice—Essentials—Two sheets—No change.

Standard Sections—Unit Specifications—Two sheets—Substitute.

Steel, Machinery—Specification— One sheet—No change.

Switchboard—Material for—Seven sheets—No change.

Switchboard—Material, Requisites—Four sheets—No change.

Subdivision Sheet T-Z—One sheet—Obsolete.

Tape, Friction—Specification—Four Sheets—Substitute.

Tape, Rubber Insulating—Specification—Three sheets—No change.

Terminology, Electric Wire and Cable—Two sheets—No change.

Train Control Automatic—Requisites—One sheet—No change.

Transformers, Single-Phase, Air-Cooled Track—Specification—Seven Sheets—Substitute.

Transformers, Single-Phase, Line, Oil-Immersed, Self-Cooled—Specification—Nine sheets—Substitute.

Trunking, Grooved, and Capping—Specifications—Three sheets—No change.

Volt-Ammeters, D.C. Portable—Specification—Six sheets—Insert.

Voltage Ranges for Signal Work—One sheet—No change.

Wires, Copper Clad Steel Bonding—Specification—Two sheets—No change.

Wires, E.B.B. Bonding—Specification—Two sheets—No change.

Wire, Line, Copper Clad Steel—Specification—Two sheets—No change.

Wire, Line W.P.D.B. Galvanized B.B.—Specification—Four sheets—No change.

Wire, Line, W.P.D.B., Copper—Specification—Three sheets—No change.

Wire, Magnet, Cop. Enam.—Specification—Two sheets—No change.

Wire, Messenger, Galv.—Specification—One sheet—No change.

Wire, Messenger, Sags for—Table—One sheet—No change.

Wire, Rubber Insulated—Specification—Five sheets—No change.

Wire, Signal, Galv. Steel—Specification—Two sheets—No change.

Wire, Insulation Resistance—Table—One sheet—No change.

Wire, Stranded and Flexible Condr's—Table—One sheet—No change.

Wire Insulating Machine—Type—One sheet—No change.

Wire Inspection Report—One sheet—No change.

Wire Crossings Over Other Lines—Specifications—Eight sheets—No change.

DESIGNS—STANDARD DRAWINGS.

Instructions for Inserting Subject Matter Adopted January, 1920.

The following arrangement is for placing the drawings in numerical order.

Title Page—One sheet—Substitute.

Index—Alphabetical.
Paging 1 to 10 inclusive—Ten sheets—Substitute.

Index—Numerical.
Paging 1 to 7 inclusive—Seven sheets—Substitute.

DRAWINGS AS FOLLOWS:

1001, 1002, 1007, 1008, 1009, 1010, 1011 and 1013—Eight Sheets—No Change.

1014—One sheets—Substitute.

1015, 1016, 1017, 1018, 1019, 1020, 1021, 1022, 1023, 1024, 1025, 1030, 1031, 1032, 1033, 1034, 1035, 1036, 1038, 1039, 1040, 1041, 1043, 1044, 1045, 1049, 1050, 1052, 1053, 1055, 1056, 1057, 1058, 1059, 1060, 1061, 1062, 1063, 1064, 1065, 1066, 1067, 1068, 1069, 1070, 1071, 1072, 1073, 1080, 1082, 1083, 1084, 1085, 1086, 1087, 1088, 1089, 1090, 1091, 1092, 1093, 1094, 1095, 1096, 1097, 1098, 1099, 1100 and 1101—Sixty-nine sheets—No change.

1102—One sheet—Substitute.

1103, 1104, 1105, 1106, 1107, 1108, 1109, 1154, 1155, 1156, 1157, 1165, 1166, 1167, 1173, 1174, 1175, 1176, 1177, 1178, 1179, 1180, 1181, 1182, 1183, 1184, 1185, 1190, 1191, 1194, 1195, 1196, 1197, 1198, 1199, 1200, 1201, 1202, 1203, 1204, 1205, 1206, 1207, 1217, 1219, 1220, 1222 and 1223—Forty-eight sheets—No change.

1224—One sheet—Substitute.

1125, 1226, 1227, 1228, 1229, 1230, 1231, 1232, 1233, 1235, 1236, 1237, 1238, 1239, 1240, 1241, 1242, 1243, 1244, 1246, 1247—Twenty-one sheets—No change.

1248—One sheet—Insert here from specification section.

1259, 1309, 1329, 1331, 1332, 1333, 1334, 1335, 1336, 1337, 1338, 1339, 1340, 1341, 1342, 1343, 1344, 1345, 1350, 1351, 1352, 1355, 1356, 1357, 1360, 1361, 1362, 1363, 1364, 1365, 1366, 1367, 1368, 1369, 1371, 1372, 1374, 1375, 1376, 1378, 1379, 1387, 1388, 1389, 1390, 1391, 1392, 1393, 1394, 1395, 1396, 1397, 1398, 1399, 1400, 1402, 1420, 1422 and 1424—Fifty-nine sheets—No change.

1459, 1460 and 1461—Three Sheets—Insert.

Symbols 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 and 13—Thirteen sheets—No change.

The P. & M. Loose Leaf Line

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